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Electronics Australia

SEPTEMBER
1987

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SPECIAL FEATURE

CAD IN ELECTRONICS

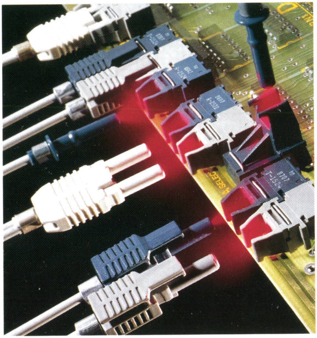
EXCLUSIVE

Local Electronics Factory Sold to Singapore!

Switch-tuned Radio to build • What's inside a phone

"Satellite" Burglar Alarm • New Carver amps reviewed

Fibre optics



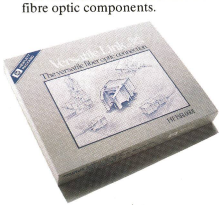
The old limits are off design constraints.

Meet Hewlett-Packard's *Versatile Link* HFBR-0501 series of fibre optic components. Innovative HP technology now makes the noise and interference immunity of fibre optics accessible and easy to use for short-distance applications. This opens up significant new voltage isolation and data communication design possibilities in pc board intercommunications, instruments, computers and test equipment.

HP's *Versatile Link* is TTL-and CMOS-compatible. Data rates can go from DC to 5 megabits/sec. Low profile mounts allow tight board stacking. Three styles of connectors, including latching and duplex, permit almost any configuration called for by your design.

Plus, it can be auto-inserted and wave-soldered. And, no optical design is required... making it remarkably cost-effective.

A comprehensive *Versatile Link* evaluation kit HFBR-0501 is available... so take the limits off yourself and contact Hewlett Packard's Australian distributor VSI Electronics for this and other fibre optic components.



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Electronics Australia

Volume 49, No.9

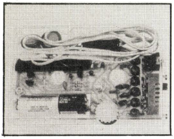
September 1987

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Shock news story

A flourishing and competitive Australian electronics factory has just been sold to Singapore. Read why in our exclusive story starting on page 20 . . .

Switch-tuned radio



Here's a compact radio that's really easy to tune — no fiddling with tiny dials! It all fits in a compact cassette case, and it's easy to build, as well. See page 58.

Special CAD feature

A bit vague about CAD? Our feature starting on page 94 will fill you in. CAD is great for drawing circuits or designing PCBs.

ON THE COVER

Sample screens from Protel, the very popular Australian-designed CAD software package available in modules for both schematic circuit design and PCB routing (courtesy HST Industries). See our CAD feature, starting on page 94.

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Letters to the editor

Loudspeaker kit problems

I was interested to see a letter in the July issue of EA from a reader "C.C. of Ashgrove, Qld" who is not satisfied with the performance of a speaker kit obtained for the Playmaster 3-way enclosures. C.C. did not state precisely what the trouble was, but I thought it may have been the same type of distortion that I experienced with the same speaker kit, which I obtained to replace some older speakers in a pair of otherwise good reflex enclosures I wanted to update.

I, too, was disappointed in their performance when they were all installed, especially at normal listening levels in the home, and often going through a series of elimination checks, suspicion fell on the crossover units.

I knew the crossover inductances were iron-cored, but as they were all made up and part of the kit, I used them as supplied. I should have known better than to use them, for the shortcomings of iron cored inductances in crossovers has been known for more than 35 years, by me anyway.

Iron cored inductances in crossovers are prone to distortion as they are undamped and can cause ringing, which results in waveform distortion. Their inductance also changes with variations in current, due to the iron, so the crossover frequency is known to vary slightly with changes of volume.

When the offending units were opened, they were seen to be connected in a quarter section, parallel connected circuit which is known also to be a source of distortion, as the inductances and capacitors can react adversely with each other in this mode, which does not occur if the same elements are connected in the series connection.

So the units as supplied were discarded, and two new crossovers were made using air cored inductances and connected in the series mode with new bipolar electros. The same values of inductance and capacity were used, and the performance greatly improved.

There is something else which may be worth noting.

There is a 90° phase difference between the speakers in a quarter section series connection, but it is not always easy to place the mid-range speaker a quarter of a wavelength (at the crossover frequency), backed behind the frontal plane of the woofer in a cabinet. This is no great problem in a quarter section series crossover as the rate of attenuation is less than in a half or ful section. It just means that the two speakers are in true parallel over a greater frequency range, and this can help to cancel core resonances.

An improvement in response may also be obtained by changing over the connections to the mid-range speaker but be wary of amplifier instability i this is done.

I changed the connections to the mid range speaker in my case, and the response was smoother and no instabilit was encountered. I'm very pleased wit the results.

Best wishes to EA and staff and welcome back to Jim Rowe.

R.J. O'Dea,
Epping, NSW.

Vintage radios

I have just read the article in you April issue by John Hill, on vintag radio restoration. At the age of twenty four I am in business for myself in m home town. I service and restore a lo of valve radios, a lot of them pre-second world war. It's amazing the numbe of valve radios still in use in my are being used in woolsheds and milkin sheds.

I do have a problem with obtainin valves for radios, and at times I have t give up on the odd radio because "beats me" or the customer and myse decide that repair would be too costl Usually when this happens I inher them for spare parts.

My opinion is that the old valve radi is a great performer, often a lot bett than the rubbish that modern technology is putting on the market plac today. One thing I will say the o radios do have a lovely tone and appearance.

As long as the radios keep comin into my workshop, I will try my best t keep them going to keep the cows an sheep happy!

P.J. Beeby, B
Balclutha, NZ.

Inverter unit: September 1985

I recently built and operated a
12/230V 300VA inverter as described in
your September 1985 issue. This in-
verter fulfilled its basic function and
proved to be a fundamentally sound de-
sign. It appears to be an update with
extra features of an earlier design pub-
lished by yourselves in February 1979.

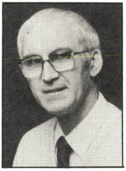
During operation a number of minor
design idiosyncracies were noted. These
were annoying in that they limited the
usefulness of the unit. Minor changes
only were needed to eliminate these
problems. You may wish to pass the de-
ails on to other readers, as some of
hem may have encountered similar
problems.

Auto starting: This circuit functions
s intended, provided that a low voltage
drop DC path exists in the 230V appli-
nce. Equipment containing triac or
SCR speed controllers, or the increas-
ngly popular mains level switch-mode
power supplies will usually fail to trigger
he inverter into action. The result is
otal frustration. The simplest fix is to
onnect a 22k resistor in series with a
lider switch between the +12V rail and
Q11 base-D12 cathode junction. Open-
ng the slider gives autostart operation,
losing it gives continuous running of
he inverter. Space exists on the front
panel for mounting the switch and label.

Voltage regulation at start up: At
tart up, a transient of maximum output
voltage maximum duty cycle occurs for
bout 1/2 second. Output then disap-
ears for about 1 second, followed by a
low rise from zero to the correct final
value. This form of start up is not al-
ways desirable. Also, high dissipation
an occur in the 2N3771's from trans-
ormer saturation during start up at
ully duty cycle. These problems are
ue to the initial absence of charge on
he 0.47μF capacitor connected to IC7a
in 3. The cure is connection of a sec-
nd capacitor of 0.68μF between IC7a
in 3 and the +9 volt rail. The output
ow ramps up smoothly without the
art-stop-start behaviour previously ap-
arent.

Control circuit filtering: Bypassing the
2 volt line to the control circuitry with
700μF in lieu of the 100μF used, and
eding this portion of the circuit via a
mall germanium power transistor con-
ected as a "super diode" to limit diode
rop, improves regulation and protec-
on on noisy, poorly regulated battery
rcuits. This becomes important if di-

ontinued on page 122



Editorial Viewpoint

A sad day for Australian electronics manufacturing

I've just finished one of the saddest stories I've ever had to write. It's our exclusive story in this issue on the demise of Appliance Control Systems, and the sale of its hi-tech manufacturing plant to Singapore.

I'm hopping mad about what happened to ACS. I believe it's a tragedy, not only for ACS and its employees, but for Australian electronics manufacturing. I also believe it's an incredible indictment of our financial community, its current practices and attitudes towards manufacturing.

What infuriates me more about this story is that it probably wouldn't have happened if manufacturers like ACS could get genuine long-term finance to build their businesses in a solid way. Not the kind of pseudo help that's currently all the rage: "Here's a few hundred grand — but we want 22% interest, or a big slice of the company. And if we buy in, we expect to get our money back in six months."

No doubt if Laurie Larsen had wanted to borrow $100 million for a few weeks to make a quick killing, the banks would have fallen over themselves to lend him more money. The problem was that he only wanted a much smaller figure, to do something constructive like building a good solid manufacturing and export business.

Frankly, I doubt whether we're ever going to get a decent manufacturing industry in Australia while our finance industry continues to be ruled by this fast-buck mentality. If a really innovative, efficient and internationally competitive little company like ACS can come to grief like this, what hope do we have? We might as well sit back and watch while countries like Singapore, Korea and Hong Kong leave us far behind. Not even counting those like Japan and Taiwan, that already have . . .

The frustrating thing about all this is that with good *long term* planning and financing, Australia could so easily build up a solid, world class and internationally viable manufacturing industry. We have the innovators, the knowledge and the skills — they're not the problem.

I don't think the answer is more Government agencies set up to "help our manufacturing industry", either. We've probably got more of those already than the countries that really are nurturing their manufacturing industry. In our case, all they seem to do is create an ever-growing army of bureaucratic paper-shufflers. Very little real assistance ever seems to filter through to the actual manufacturers who need it and could put it to efficient use.

We desperately need a genuine, no-bulldust commitment to manufacturing, or Australia the banana republic is almost inevitable. By the way, guess whose electorate ACS was in — why Paul Keating's, of course. Ironic, that.

Jim Rowe

What's New In Entertainment Electronics

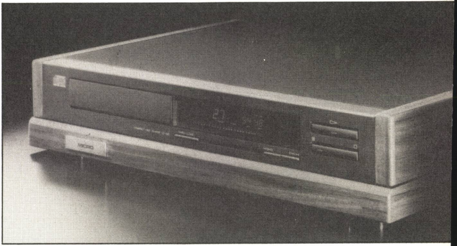
Professional CD player

Audax Loudspeakers has announced the release of the long awaited CD-M2 compact disc player from Micro Seiki in Japan.

Micro Seiki's design philosophy has been the elimination of external and internal vibration and this accounts for the heavy grade zinc-aluminum top panel, based on a newly developed COSMAL-Z alloy. This is a newly developed metal designed for extreme rigidity and vibration damping characteristics, compared to conventional aluminum alloys.

To further eliminate vibration the bottom panel of the CD-M2 uses a triplex vibration damping structure comprising of lead, ferrite and alloy materials. In addition, the chassis frame rigidity is assured by the use of a zinc diecast frame. These special materials give the CD-M2 a weight of 22kg. Micro Seiki claims that such careful attention to the use of internally strong materials leads to previously unheard-of sound quality in a compact disc player.

The power supply unit incorporates a very large power transformer featuring a triplex shielding structure and a shorting strap, hum proof belt and copper-plated steel case to minimise leakage flux into other circuits. Independent power supply circuits are used for each of the digital PCB, analog PCB, servo mechanism and fluorescent display sections, to eliminate the risk of logic pulses interfering with adjacent sections. The result, Micro Seiki claims, is a previously unobtainable transparency and extremely high signal to noise ratio (140dB).



The CD-M2 offers 4 times over sampling (176.4kHz), true to 16 bit vertical resolution, twin D/A converters and crosstalk of better than –100dB. It also features a 16 bit, oversampling digital filter, and a third order Bessel filter for higher resolution and increased linear phase characteristics.

Multiple output configurations offer 600 ohm balanced XLR cannon connectors for professional use, single ended 2V RCA gold connectors, a fivefold sandwich structure, quadruple static shielded transformer and a balanced line output offering two cannon to gold plated RCA connector cables supplied as a standard accessory.

For direct to digital transmission th unit provides a digital output and an optical output. Full remote control offers program play, direct access play one track/whole track program repeat track/index search and program scan.

The CD-M2 is designed for high quality and professional systems and will retail for $5,500. It comes with a full two year warranty.

Further information is available from Audax Loudspeakers, 295 Huntingdal Road, Huntingdale 3166, or from Audi Investments, 5 Towri Close, St Ive 2075.

Dash mounted car CD

Sony Australia has released the CDX-R88 automotive CD player system, with inbuilt FM/AM tuner and power amplifier. The new model is designed to fit DIN size automotive dash mounts.

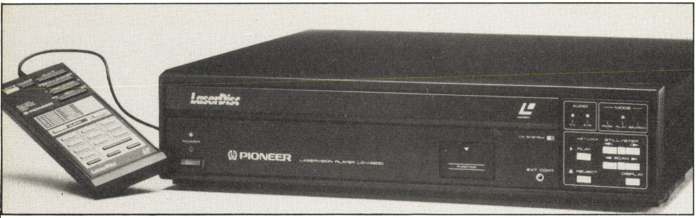
The CDX-R88 is equipped with a 25W per channel amplifier. The CD functions include AMS (Automatic Music Sensor) letting you select the individual track you prefer. The manual search function allows cue and review operations, and the return button lets you automatically return to the beginning of the first selection on the disc. It also has auto repeat, which automatically plays back the selected disc once the original tracks have been played.

The high sensitivity, high performance FM/AM tuner has 18 station pres tuning (12 for FM stations and 6 f AM stations) plus seek tuning, whic tunes into the next strong station up down the band.

Another interesting feature of th CDX-R88 is the digital display indica ing elapsed time or track number whi the CD is playing. The unit also inco porates line in/out jacks to integra with existing car installations or futu system expansion.

The CDX-R88 is available no through the Sony dealer network at suggested retail price of $1,499.

For further information contact So (Australia), 33-39 Talavera Road, Nor Ryde 2113.



Laserdisc players

Pioneer has launched a new range of NTSC Laserdisc players, from the robust LD-V2000 through the flexible LD-V4200 to the advanced state-of-the-art LD-V6000A.

The LD-V2000 is primarily designed for demonstrations and presentations, boasting a high image clarity with 400 lines of horizontal resolution. With its self-detecting CX Noise Reduction on, the signal-to-noise ratio is better than 70dB. A variety of servo mechanisms and circuits reduce distortion to a very low level. The LD-V2000 is available for approximately $800.

The next level of sophistication takes you to the LD-V4200 with a RS-232C port interface. This allows easy connection to a wide variety of computers and sophisticated software. Complex controls in the LD-V4200 are simplified with the use of Mnemonic Command Language. Random Access Programming allows rapid search with minimal disturbance of images on-screen. Multi-speed play allows variation of the playback speed.

The LD-V4200 also features a built-in video overlay character display, allowing the user to overlay up to 20 characters of 8 lines against the video material or a blue matte background. The LD-V4200 is priced at $1,375.

The LD-V6000A is the state-of-the-art laserdisc player. It is designed for the most sophisticated industrial, multi-screen and simulation applications. High speed random access coupled with an initial mapping system accesses any frame in under two seconds.

Flexibility in the LD-V6000A comes from the easy interfacing of a wide variety of computers and sophisticated software. What's more, program bump disc playback allows for both constant angular velocity (CAV) and constant linear velocity (CLV) discs. External synchronisation and subcarrier inputs allow colour phase adjustment and horizontal synchronisation of playback video to an external reference signal in multi-screen and other operations where critical video timing is required.

The LD-V6000A is capable of use in manual mode (Level 1), as a self-contained programmable interactive system (Level 2) and through interface with an external computer control (Level 3). It is priced at $2,500.

For more information contact Laser-Disc Division, Pioneer Electronics, 178 Boundary Road, Braeside 3195.

New CD players use opto-coupling

Onkyo's new top of the line Integra DX-530 compact disc player incorporates a novel opto-coupling technique, together with the addition of a host of new control features. The opto-coupling technique is claimed to produce a clearer and more natural sound, free of any edginess.

The DX-530's random 20-track music calendar shows the track numbers in the order in which they will be played back, in addition to the single track currently playing, as well as playing time.

Two-times oversampling/digital filtering is used, doubling the normal sampling frequency. This raises the lower end of the ultrasonic noise spectrum.

The full range of Onkyo CD players are available from Hi-Phon Distributors, 1/356 Eastern Valley Way, Chatswood 2067.

Shotgun stereo microphone

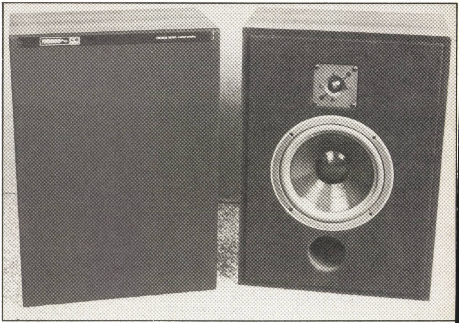
Designed for stereo location reporting amid noisy surroundings, the Neumann RSM 190i system comprises a shotgun stereo microphone with windscreen, a matrix amplifier, and all connecting cables.

Neumann says the system is also ideal for stereo television, where soloists can be accentuated with presence and middle emphasis, while the orchestra can be picked up with a variable, wide bass width. Another application for the RSM 190i System is for live or dubbed stereo film sound.

Two closely spaced capsule systems ensure particularly clean and colouration-free reproduction. A transducer with a short interference tube delivers the middle signal. The side signal is supplied by a second independent capsule system comprising two transducers with a figure-8 characteristic at right angles to the microphone axis.

The RSM 190i can be operated in a hand held position, attached to floor stands or booms. The system is stored in a robust, aluminium carrying case which can also accommodate a complete microphone mounted in a windshield, plus other equipment.

For further information contact Amber Technology, Unit 6, Forestview Park Estate, Frenchs Forest 2086.



Australian designed monitor loudspeaker

Audiosound Laboratories has released the Prague 8045A, a high performance two-way medium size loudspeaker system designed for small studios, control rooms and situations where accuracy and moderately high power levels are required. It is also suitable for high quality public address, and its slim depth facilitates wall mounting or array stacking on a suspended platform.

The 8045A has close tonal balance to imported high cost studio monitors and for critical adjustment is fitted with 3dB switched attenuators for final balance of the midrange and treble. For its size the 8045A offers very good low frequency performance as the redesigned vented enclosure now incorporates a vented magnet woofer with high temperature voice coils. Like all other Audiosound loudspeaker systems it is computer correlated to accepted Thiele/Small parameters, these correlations being done in conjunction with Mr A.N. Thiele himself. The bass response is –3dB at a low 42Hz (many loudspeakers quote their bass rolloff at –6dB).

The extensive crossover system utilizes *air-cored* coils and polyester capacitors with a modified third order (18dB)/octave) Butterworth filter feeding a high performance dome treble unit. This gives much improved power handling and phase performance compared with the normally used 12dB/octave crossovers and ferrite or iron cores.

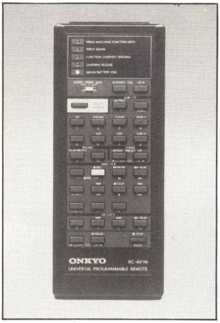
Efficiency is around 89dB/(1 watt, 1 metre) and it is suitable for amplifiers from 10-100 watts. The rigid enclosure features a 25mm MDF baffle and back with multiple front-to-rear and side-to-side bracing. The bass-unit mounts on 4 pillars which form part of this rigid system for low sound colouration from the enclosure. Outside dimensions are 610 x 440 x 260mm (HxWxD).

Further details are available from Audiosound Laboratories, 148 Pit Road, North Curl Curl 2099.

"Universal" remote control

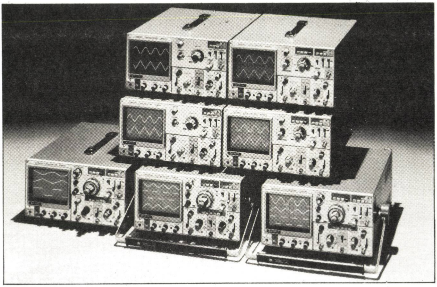
The audio-visual age is upon us, and almost every new component that is produced has its own remote control unit. In response to the problem of the increasing number of separate units that are now necessary to operate today's technology, Onkyo has developed the RC-AVIM Universal Remote Control, which enables the user to dispense with the clutter of key pads and operate up to six components from a single remote control.

The RC-AVIM can not only control any Onkyo remote controlled product, but can be programmed to imitate virtually any components operated by infrared remote control, from any manufacturer. The RC-AVIM can learn the functions of as many units as its memory can store (tuner amp, video disc player and video cassette recorder, for example). The RC-AVIM is the first unit of its kind and provides the key to a successful marriage of audio and video.



The RC-AVIM is available from Hi-Phon Distributors, 1/356a Eastern Valley Way, Chatswood 2067.

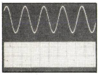
KIKUSUI'S COS-5000TM SERIES
THE OTHERS SIMPLY DON'T COMPARE

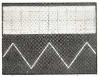


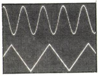
It's the standard features that make Kikusui CRO's exceptional.
The NEW COS-5000TM series offers standard features, normally only found on expensive, higher bandwidth scopes.
Consider:

1 Bright and sharp signal traces with Automatic Linear Focus. This eliminates the need to readjust the focus during measurements between timebases. Even in high intensity, there are no blooming effects.

2 'Simultaneous' triggering of both CH1 and CH2. The VERT MODE displays both signals whether they are synchronised or not. An indispensable facility when troubleshooting between working and faulty boards.

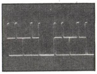


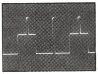




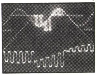
3 Auto setting of the optimum triggering level. In AUTO TRIG LEVEL LOCK, a peak to peak detector locks onto and tracks the trigger signal. There is no need to reset the trigger level between measurements.
The Manual Level Control provides superior triggering of complex waveforms or very low level signals.

4 Stable viewing of complex waveforms. The VARIABLE HOLDOFF control allows the easy viewing of waveforms such as uP or video signals with multiple triggering edges, caused by different frequency and level components.


NO HOLDOFF


WITH HOLDOFF

5 Simultaneous display of original and magnified waveform. Kikusui's ALTERNATING SWEEP MODE allows both the original waveform and the selected magnified portion to be viewed simultaneously.



6 Advanced new design using energy saving circuitry. The newly developed Dynamic Bias Circuit [PAT PEND] automatically controls the power consumption of the unit. Another feature in Kikusui's policy of continued innovation.

Features	5100TM	5060TM	5041TM	5021TM	5020TM
Bandwidth	100MHz	60MHz	40MHz	20MHz	20MHz
Channels	3	3	2	2	2
Vertical Sensitivity	1mV/DIV	1mV/DIV	1mV/DIV	1mV/DIV	1mV/DIV
Max Sweep Speed	2ns/DIV	5ns/DIV	20ns/DIV	20ns/DIV	20ns/DIV
Delayed Sweep	YES	YES	YES	YES	NO
Trigger Modes	CH1, CH2, VERT MODE, LINE, EXTERNAL.				
Alt. Sweep	YES	YES	NO	NO	NO
Delay Line	YES	YES	YES	NO	NO
Accel. Voltage	18kV	12kV	12kV	2.2kV	2.2kV
Warranty	2 YEAR WARRANTY ON PARTS AND LABOUR				
Probes	2 QUALITY SWITCHABLE PROBES INCLUDED				

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New Carver "magnetic field" PM-175 & PM-350 power amplifiers

Carver power amplifiers have established a solid reputation for innovative technology that delivers a lot of audio power from a surprisingly small (and cool running) box. These two new models continue the tradition.

Designing audio power amplifiers using traditional methods has always tended to involve various trade-offs. If you wanted high power, you went for output stages working in class AB or B, in order to achieve reasonable efficiency — or in other words, not too much electrical power in for a given amount of power out to the loudspeakers. But this approach tended to give relatively high distortion, making it necessary to apply large amounts of negative feedback if reasonably high quality reproduction was needed (and generally even then the purists still weren't happy).

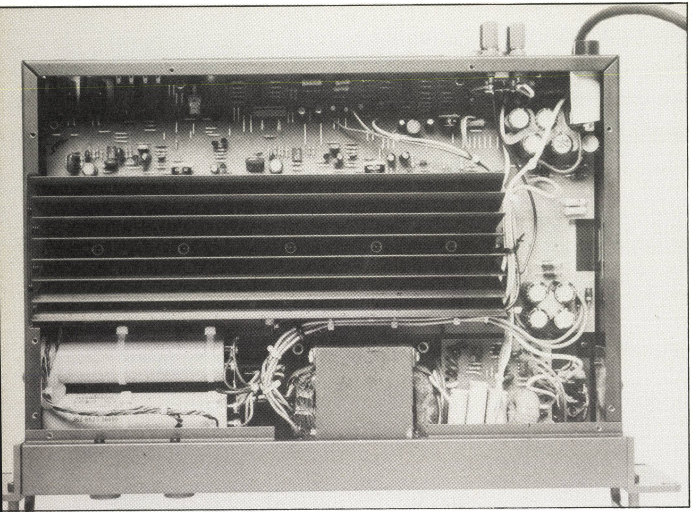
The alternative approach was to use output stages which worked in the more linear class A mode, and gave lower distortion as a result. However these were also a lot less efficient, wasting a much greater proportion of the incoming electrical power as heat. So that where higher power was needed as well as class-A performance, the amplifier needed a very heavy-duty power supply and elaborate cooling. It also tended to need fairly elaborate protection circuitry, to make sure the output stages didn't become thermally unstable and destroy themselves. Needless to say all this tended to make the price quite steep as well.

Over the years, designers tried various ways to get around these limitations. Some tried a sliding-bias approach, where the output stages operated in the low-distortion class A mode at low power levels, and gradually moved into class AB and finally class B as the signal level was increased. Others tried a technique which came to be known as "current dumping", where there were effectively two sets of output stages in tandem, one set working effectively in class A and the other virtually in class C so they simply provided pulses of current to augment the class A stage output when this was needed for signal peaks.

Still another approach was to have what was essentially class-A (or at least AB) output stages, but operating from relatively low supply voltages at low signal levels. Then special circuitry would sense when higher signal levels were making greater demands on the outpu stages, and switch in higher supply voltages to allow them to cope.

There were various other techniques and they all tended to give reasonable results up to a point. But high-power amplifiers still tended to be big, heavy and relatively inefficient.

Front view of the higher powered Carver PM-350. The PM-175 is virtually identical, and exactly the same size. Both are finished in an attractive dark grey matt lacquer.



Inside the PM-175. The PM-350 looks very similar, having a larger power transformer and a small cooling fan to the right of the heatsink extrusion. The triac and capacitors are at lower right.

Then about eight years ago, the audio and hi-fi magazines all began buzzing with news of a radically new "magnetic field" amplifier design that was capable of producing incredible amounts of audio power, from a tiny box. The new design had been developed by Bob Carver, a US engineer-entrepreneur who had previously been the founder of Phase Linear Systems (where he had developed the PL super amps, and a noise reduction system based on autocorrelation).

At first the details of the new approach were very sketchy, and seemed to consist of little more than marketing "hype". But gradually the design details emerged, and it was seen that Bob Carver really had made a highly innovative contribution to the technology. His company Carver Corporation flourished, and since then it has diversified into other areas such as FM tuners and CD players — all with the innovative Carver touch.

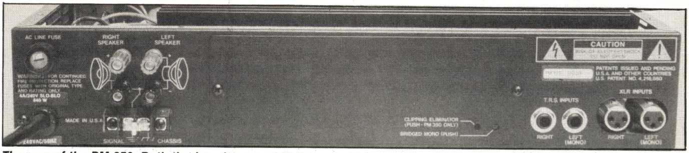
Along the way the firm's original magnetic field amplifiers have been developed and refined from the original "magic cube" M-400 model, and the models PM-175 and PM-350 shown here are from the latest range. They're nominally rated at 175W per channel and 350W per channel respectively, into 8 ohm loads and with both channels driven. However the PM-175 can also deliver 300W per channel into 2 ohm loads, or 500W into a single 8 ohm load in mono bridging mode. Similarly the PM-350 can deliver up to 450W per channel into 2 ohm loads, or no less than 900W into a single 8 ohm load in bridging mode.

All this from boxes which, although they're rather more conventional looking than the first Carver amp, can still be lifted in one hand — although in the case of the PM-350, not for very long!

How's it all done? Well, one aspect of Carver's "magnetic field" principle is that it uses a special power transformer, with a deliberately high leakage inductance in the 240V primary winding. A triac device is connected in series with the primary, and is fed with a control signal derived from the amplifier's audio input signal (via an opto-coupler for isolation). When there's little or no signal, the triac is barely turned on, and the power drawn from the mains is quite low — hence the cool operation. But when the signal increases, the triac turns on and delivers more power.

A bank of capacitors also connected in the transformer primary circuit are used to create a resonant circuit. The purpose of this is to make use of the energy stored in the transformer's leakage inductance, to allow the power supply to deliver pulses of power extremely rapidly in response to audio signal peaks. And this is essentially the "magnetic field" principle, as far as we have been able to determine.

However along with this technique, Carver also uses the idea of dynamic supply voltage switching on the DC side — but taking this principle still further. In this case the transformer secondary



The rear of the PM-350. Both tip-ring-sleeve and XLR input connectors are provided, for both channels. Recessed switches are used for bridged-mode mono and clipping elimination.

has three sets of output voltage taps, and each set are taken to separate rectifier/filter circuits delivering three pairs of supply voltages — nominally +/-25V, +/-50V and +/-80V respectively. A special "commutating circuit" switches these supply voltages in or out, again in response to the incoming audio signal.

Ah, you may say, so that's the secret of the Carver — a really fancy audio-modulated power supply, driving what is presumably a fairly normal amplifier. No, not quite!

In fact this "fancy audio-modulated power supply" doesn't just drive the power amplifier, it actually *is* the power amplifier. Or more accurately, it's the beefy part of it.

Essentially, the combined effect of the audio modulated magnetic field and commutated supply rails is to produce a high power step-approximation version (i.e., a bit rough) of the input audio. What then happens is that a small and highly linear output stage with lots of negative feedback applied is used to "smooth up" this rough approximation, to produce the final output signal. This amplifier doesn't need to handle high power, because it's really only correcting the errors — and handling the higher frequencies (where there isn't much power).

So in a Carver amplifier the power supply and power amplifier are really integrated into the one functional entity. In some ways this seems to be the really innovative aspect of Bob Carver's contribution to the art.

What about the two channels of a stereo amp? With the power supply so much an integral part of the amplifier(s), you'd perhaps expect two totally separate supplies for stereo. But as far as we've been able to determine, that's not so.

Presumably Carver's thinking behind this is that with the vast bulk of stereo program material, most of the energy is essentially mono and common to both channels. It also tends to be concentrated in the lower part of the spectrum. So a common "rough approximation" circuit would not be inappropriate, provided that the separate smoothing and error correction amplifiers in each channel are designed to cope with normal content differences between the two stereo signals.

Both the PM-175 and PM-350 amplifiers come in compact 19" rack mounting cases, only 90mm (3.5") high and 350mm deep overall. The PM-175 has a mass of only 8.6kg and the PM-350 only 9.5kg. Both are tastefully styled, with a dark grey matt finish.

The only controls on the front of both models are a pair of volume controls and a power switch. Apart from this there are four indicator LEDs showing respectively power, signal present, whether or not either channel has entered clipping, and the presence of a fault condition. Both amplifiers are able to detect the presence of either a short-circuited load, or a sustained overload condition, and will turn themselves off to prevent damage to either the amplifier itself or the loudspeakers.

At the rear of both models there are the loudspeaker terminals, two kinds of input connectors for each channel (both 6.5mm tip-ring-sleeve jacks and XLR-type sockets, with active balancing), and a mono bridging switch accessible via a small hole in the back panel. The last-named of these allows the phase of one channel to be reversed, so that the two can be used as a bridged-output mono amplifier.

The PM-350 also has a second switch accessible via a hole in the back panel, to enable or disable a hard-clipping eliminator circuit. When enabled, this limits amplifier clipping to 3% THD, even when it is overdriven.

Both models feature slow start-up, and input muting during the switch-on period to prevent "thumps".

The interior of both models is almost identical, with a large PCB in the centre bisected by a length of extruded heatsink. This is used to dissipate power from the 20-odd power transistors used for commutation and the output of each channel's error correction amplifier. In the PM-350 there is a small DC motor fan used to pull air in through the side of the case and blow it over the heatsink, but in the PM-175 this is apparently not needed.

At the front of the case in each unit is the power transformer, with that in the PM-350 a little larger than the other, but both surprisingly small for the power levels involved. Alongside the transformer on one side are the main reservoir electros, and on the other side a small PCB with the resonating capacitors and other circuitry needed on the 240V primary side of the "magnetic field". The triac is mounted on the case just near this smaller PCB.

Well then, how did the Carvers check out in practice? On the power output side, they certainly delivered an impressive wallop. The PM-175 delivered its rated 175W per channel into 8 ohms with both channels driven, with only .05% THD at 1kHz and below — well below the quoted 0.5% maximum. And it produced very near its rated 250W per channel into 4 ohm loads, again for 0.5% THD at 1kHz and below.

Similarly the PM-350 easily produced 390W per channel into 8 ohm loads, again with both channels driven, for only 0.15% THD at 1kHz and below. It even produced 500W per channel into 4 ohm loads, with both channels driven, or 1000W into a single 8 ohm load in bridged mono mode — for only 0.3% THD at 1kHz and below. Very impressive!

What we did notice, however, was that the THD began to rise noticeably above about 3kHz, for continuous test signals producing over 20W output per channel for the PM-175, and about 40W per channel for the PM-350. Looking at the output with a scope, you could see "kinks" appear in the output at these power levels — but only on signals above 3kHz or so. For 20W continuous output into 8 ohm loads, for example, the PM-175 reached the rated 0.5% THD level at about 8.5kHz. We suspect that this is some peculiarity of the commutation circuitry.

Just in case this was due to the continuous test signals, we tried doing toneburst tests at 10kHz with the same 24:1 duty cycle as for the IHF dynamic headroom test. The results were virtually identical.

So it would appear that the Carvers don't have a flat power response — at least for continuous testing. This may not necessarily cause problems in practice, as typical musical material doesn't have much of its energy in the high frequencies. But when the Carvers are called upon to produce full rated output with musical signals, it's possible that the material above 3kHz could amount to over 20W.

The normal frequency response for both models was excellent, at 6Hz — 70kHz between -3dB points. Hum and noise were also quite low: the PM-175 gave approximately 98dB below 200W output into 8 ohms.

The channel crosstalk figures we obtained were all better than -60dB for both models, even at low and high frequencies. This shows how good the error correction circuitry must be in the two stereo channels.

An interesting result was produced when we did the standard IHF tests for dynamic headroom: the ability to produce higher instantaneous power for short peaks, than for continuous operation. Here we discovered that both models produced a figure of virtually 0dB — the output power available for peaks is the same as that for continuous operation!

Actually that's hardly surprising, when you consider the way the Carvers operate. Essentially, they're always capable of producing their peak output — on a continuous basis if required, not just in short bursts.

There were only a couple of other points we noted, both relatively minor but interesting. One was that when taking THD measurements below 800Hz, the distortion meter needle would "hunt" over a small range, and the scope showed a slow beat component present in the residual signal. We're only talking about a low level — varying from typically .01% to .025% effective THD — but it was noticeable on the instruments, for both models. We suspect this is due again to some low level commutation effect.

The other point was that in the PM-350, the speed of the cooling fan varies according to the signal level. For small signals it runs slowly, while for large signals it speeds up. This is quite appropriate, of course, considering the way that the Carvers only draw and dissipate power when they need it. Presumably it's achieved automatically by running the fan motor from the commutated power rail.

In our listening tests, which were admittedly a little limited due to lack of time and appropriate facilities, the Carvers sounded fairly clean. We couldn't actually detect any adverse effects attributable to the suspected commutation phenomena, suggesting that they may not to be a problem in real-world applications.

To summarise, then, the Carver PM-175 and PM-350 are very innovative amplifiers. They certainly deliver a lot of power relative to their modest size, and seem very well suited for applications such as sound reinforcement, stage and PA work. But those residual commutation effects at higher frequencies seem likely to limit their appeal in the most demanding of hi-fi applications.

Recommended retail prices for the PM-175 and PM-350 are $2390 and $2850 respectively. Further details on these and the other Carver products are available from distributors the Odyl Group, 112 James Street, Templestowe 3106. (J.R./R.E.)

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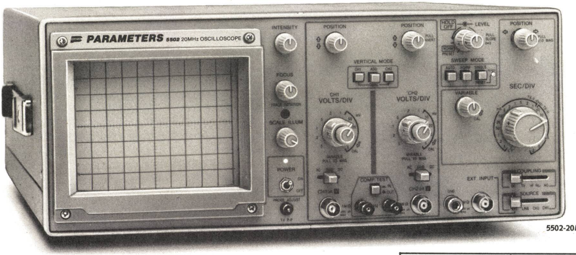

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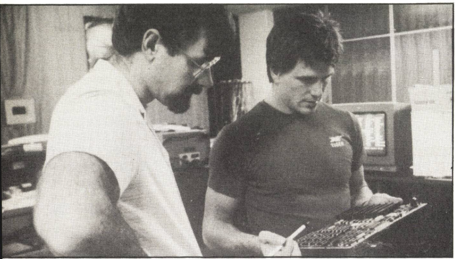
New hope in electronics for the unemployed

by PAUL GRAD

There's an electronics workshop in Sydney's inner suburb of Surry Hills which looks pretty much like any other, but is quite special. The young people who work there are specially enthusiastic, because only a while ago they were unemployed and facing a bleak future. The workshop is part of a training program to help people find a job with industry, and most of the people who joined the program have since found a job.



Sydney ITeC's manager Steve Lawrence (left) discusses a problem with ecturer Tom Gunthorpe in the electronics workshop.

The workshop is part of the Sydney nformation Technology Centre (ITeC), he first of three so far established in Australia, the other two being in Melbourne and Perth.

The Centres provide training for the ong-term unemployed and for people vho are disadvantaged in the labour market. They plan to include business people and members of the general public n the near future.

They are sponsored partly by the Federal Department of Industrial Rela-ions and partly by private industry. Soon they will raise some of their own ncome through commercial training and ITeC-owned business ventures.

Sydney's ITeC has been set up by Peninsula Community Services Ltd (PCS), a non-profit employment development agency. It is supported by several businesses, including computer manufacturers, electronics and high-tech companies.

It organised an open day on July 7, during which representatives of some of he supporting businesses visited the entre.

Showing great interest in the training program, representatives of some of the computer and electronics companies which support the centre said that it is difficult for the companies to find personnel with the skills and experience they need.

They need people willing and able to start at the grassroots level, to become quickly able to actually "do" something. They said graduates from tertiary institutions usually want to start already at a fairly advanced position within the company, but many of them know only how to study.

At the centre the students, who are paid an allowance during their course, can work at their own pace and find out which is the kind of work they like best and for which they are best suited.

The centres provide a "hands on" experience in a work environment, and not in a classroom. It combines practice with theory and uses real work projects.

The Sydney centre's manager, Steve Lawrence, said "We want our students to be able to operate effectively from the very start in a new job, and not be in any doubts about their abilities."

Sydney's ITeC provides two major training programs: computer and office skills, and electronics. The courses range from 12 to 20 weeks full-time.

The computer and office skills course introduces students to computers and most aspects of computer applications including word processing, databases, spreadsheets, printing, basic electronics and programming.

Computers used in the centre have been donated by IBM, NCR, Epson, Apple and Olivetti.

The electronics course covers both theory and practical work including soldering, component identification, fault finding and basic computing.

Students at the Centre have built various types of equipment including counter programmable clocks, light chasers, car and house alarms, and a solid-state switchbox to switch eight computers to two printers.

The centre at Sydney has been operating since September 1986 and those in Melbourne and Perth, since the beginning of this year.

Sydney's centre has eight students. 12 of the initial 20 students have found a job. The centres at Melbourne and Perth each have 10 students.

Melbourne's centre, managed by Mike Auden, was set up by the non-profit agencies Melbourne Citymission and Westernport Regional Development Committee.

The ITeC centre at Perth, managed by Phil Schwenke, was set up by Anglicare (Anglican Health and Welfare Service), a non-profit employment development agency.

The initiative to establish the centres came from Federal Minister for Employment and Industrial Relations Ralph Willis. Last September he released a report from the National Training Council on a scheme called ITeC (Information Technology Centres), subsequently announcing the government's intention to establish three pilot ITeCs during 1986/1987.

The centres are modelled after training institutions which have been operating in Britain since 1981. Each year about 5000 young Britons receive training in information technology applications in 175 of those institutions.

CCML — new logic circuit family developed in Australia

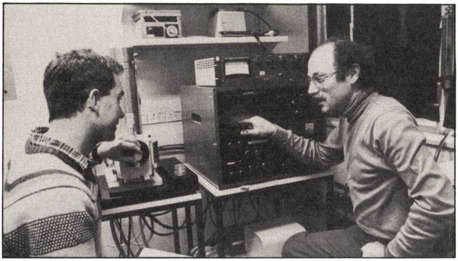
A new Australian-developed logic circuit family could have the potential to give new directions to the computer industry throughout the world, even while the giants like IBM and Fujitsu have been investing hundreds of millions of dollars in computer-related R&D every year.

by PAUL GRAD

It could also be another case of an important Australian brain-child which is commercialised only overseas, with Australia paying for imports of equipment based on a local idea. Manufacturing the new circuits would involve setting up an entirely new plant requiring an initial investment of about $50 million and the required R&D would, as with the large manufacturers, cost hundreds of millions of dollars.

It was therefore understandable that there was some surprise when Dr Chris Horwitz of the University of NSW's school of electrical engineering and computer science proposed the new logic during the 1987 International VLSI Circuits Symposium in Japan, last May. Horwitz, who went to Japan at the invitation of the symposium organisers, had previously attracted attention with his invention about two years ago of a plasma etcher for chip manufacture, which is now being commercialised in Australia.

He claims the new logic, called Complementary Current Mirror Logic (CCML), which he developed in cooperation with the school's professional officer Mark Silver, has the potential to allow combining the high speed of operation of bipolar chips with the large-scale integration of MOS chips.



Mark Silver (left) and Chris Horwitz, developers of the new logic family, discuss a point in their lab at the University of NSW.

It would thus make it possible fo PCs to operate with the speed of exist ing mainframe computers.

Although several types of logic circu are currently used, they are all based o variants of two kinds of active compo nents, bipolar and field-effect transis tors.

Their fabrication processes are sim larly based on two technologies, bipola and MOS.

Bipolar chips are faster than MO chips, but dissipate more power. Th higher power dissipated by bipolar chip limits the level of integration achievabl with them.

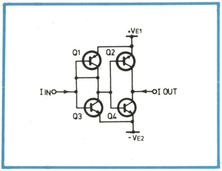
A far higher level of integration achievable with MOS chips, which ar therefore used where small size equipment is wanted and where opera ing speed is not paramount.

Dr Horwitz says that attempts reducing the power dissipation of bipo lar chips led to two main developments One of them was the refinement bipolar processing technology, whic has permitted low gate operating cu rents with self-aligned PNP and NP transistor constructions. The other wa the improvement in high-speed bipola gate designs from emitter-coupled log (ECL), operating with a voltage swin of 500mV, to non-threshold logic (NTL and current-mode logic (CML) using voltage swing of 300mV.

These low voltage swings have in creased the speed of bipolar chip opera tion even further and have also lowere their power dissipation, due to the sho time and the low energy required t charge gate inputs and interconnections

However, the continuous curren drain of bipolar gates still prevents the integration to the levels possible wit complementary MOS (CMOS), whic only draws power when signals change.

Several ideas have been advanced t lower the standing current in bipola circuits, including using complementar



Basic configuration of the new Horwitz-Silver CCML inverter stage.

bipolar devices combined with careful power supply voltage control, storing charge in input diode networks, and using bipolar and field-effect combinations.

The new Horwitz/Silver CCML circuit consists of bipolar current mirror elements connected in complementary configurations, operating primarily on current levels rather than voltages.

While this configuration requires charging up current levels on lines, Horwitz said, the energy levels required by currents are far less than for voltages on typical lines.

CCML circuits have a very low power dissipation in the absence of input signals and a low, tailorable signal voltage swing, which may be of the order of 100mV.

Compared with field-effect configurations, CCML circuits require a lower signal voltage swing for a given output current swing, which Horwitz believes gives CCML circuits a significant speed advantage over field-effect circuits.

Horwitz said he was recently encouraged to learn that the fact that CCML configurations use both PNP and NPN transistors need not bring a disadvantage, despite "received wisdom" that PNP transistors are slower than NPN ones. Before going to Japan he talked to Prof Richard Swanson at Stanford University. Swanson's latest work suggested PNP transistors have the capacity of being faster than NPN transistors.

Minority carriers in the PNP transistors seem to travel faster than minority carriers in the NPN bases, Horwitz said.

Therefore, in bipolar circuits we can get some advantages over CMOS circuits if we mix both polarities.

At the symposium he described a bipolar implementation of a CCML inverter and the implementation of binary functions in CCML.

In the inverter the mirrors may have multiple outputs, or an output current which is a multiple or fraction of the input current. The power supply voltages are typically + and — 0.5V, resulting in almost zero gate current in the absence of an input signal.

An input current causes a proportional output current to flow, resulting in a basic inverter action which may be binary, ternary or multi-valued. The multi-valued action would result if the input current levels were variable.

When tested for binary action a discrete-transistor implementation of the CCML inverter compared very favorably with ECL circuits made from the same transistors used in CCML, Horwitz said. The average gate delay of the ECL circuits was shown to be 3 or 4 times longer than that of the CCML inverter, at a given gate power drain.

Horwitz says "CCML circuits have a big advantage over ECL in that ECL needs an emitter follower buffer stage to drive into any off-chip lines (typically of 50 ohm impedance). No such buffer stage is needed by CCML circuits" .

From the test results, Horwitz expects the CCML power drain in practical applications will be less than 1/4 of that of ECL circuits in the presence of an input signal, and close to zero — as with CMOS — in the absence of an input signal.

In simple CCML circuits used to implement binary functions, some of the power advantage of CCML over ECL is lost, due to the larger number of individual gates needed in the CCML configuration to make up a single function.

The advantages of CCML over ECL become more apparent in the more complex applications due to the current-summation properties of CCML.

The variable output current levels resulting from the current-summation can lead to saturation of the output devices, if the output currents are limited with a resistor or a series current mirror element. To avoid a lowering of the operating speed, Shottky clamping is used in such cases.

Horwitz' work on CCML has been supported by the Joint Microelectronics Research Centre at the University of NSW, ATERB, and the Faculty Research Grants (University of NSW). In the past the Radio Research Board supported the project.

He said "I am grateful also to the Japanese symposium organisers for inviting me to present this new logic in a special "high speed logic" session. The interest it attracted, specially from one of the largest Japanese telecommunications companies, leads me to hope that CCML will shortly find its way into practical applications." EA

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WORKSOUTH 242 A

SA electric vehicle enthusiast builds

An Electric Morris Minor Ute!

You've heard about those dedicated people who buy old Morris Minor cars and do them up? Here's a story with a difference — not a normal rebuild, but a complete conversion to electric drive.

by E.C. HURFORD

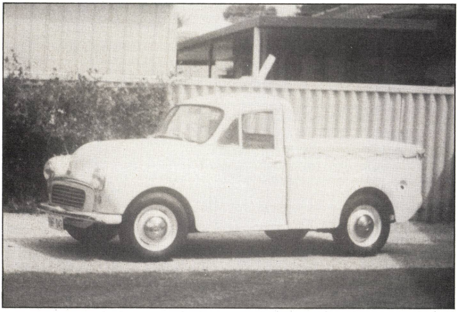
In the mid 70's I bought a Morris Minor ute (pictured) but without the IC engine. Following this I bought an electric "Tow Motor" of the 1930's vintage. I removed the electric motor, the nickel-iron cells and the controller. The controller being hand operated, I had to convert it to foot operated via an accelerator pedal. The rest of the Tow Motor I dumped.

Next I removed the ute's radiator, petrol tank, and any pieces not required. Then I proceeded to fit the electric motor where the IC engine had been and direct coupled it to the existing gearbox. The Edison nickel-iron cells were already in a frame, so it was just a matter of bolting the frame into the utility's tray. This conversion proved only partly successful because the gross vehicle weight was 1.2 tonnes — too heavy for any respectable turn of speed.

Also the nickel-iron cells, being 35-40 years old, did not have the capacity to hold a decent amount of charge and their total weight was over 900lbs.

Come 1984, I decided to have another go, removing the nickel-iron cells and replacing these with six CX5 Chloride lead-acid batteries arranged in series/parallel to give 36V.

Next the motor, which was a 48V series motor I removed the series field coils and replaced them with shunt wound coils. Now I had regeneration, and by field weakening through adding resistance via the controller, an increase in speed.



The new batteries, being total weight 500lbs, reduced vehicle weight by at least 400lbs, which helped speed. A further reduction could be achieved by a lighter, more modern motor, but I am reluctant to remove the old robust motor.

I have a KWH meter on the battery charger, to check the charging cost.

On the vehicle I have an amp/hr meter, which reads the amount of charge removed or put in the batteries. In other words, whether the batteries are full, empty or in between.

On the dashboard there is a voltmeter, an ampmeter and also speed and distance meter.

I have now added 2 more CX5 Chloride 12-volt batteries. This now give me two banks of 48 volts used in parallel. This gives greater capacity. There is a separate 12-volt battery for auxillary equipment.

I use the gear box for gradients where necessary, but usually start in 3rd or 4th on flat terrain.

Start and acceleration is as follows:

First Stage: Full volts on field and full resistance in series with armature.

Second Stage: Full volts on field, reduced resistance in series with armature.

Third Stage: Full volts on field and no resistance in series with armature.

Fourth Stage: Weakened field with resistance in series. Full volts on armature.

No electronic control, just old fashion control — perhaps wasteful of power in resistance, but only momentarily, at most times.

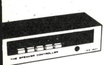
(Reprinted from "Electric Vehicle News", by courtesy of the Australian Electric Vehicle Association Inc.)

NEW! NEW! NEW! NEW! NEW!

D PLAYER ADAPTOR

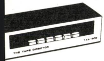
ny amplifiers have only one iliary input. This makes using a npact disk player as well as ther auxiliary input inconvenient. the majority of CD players have output voltage of 1·6 or 2 volts ereas the auxiliary input norm is mV. This CD adaptor allows dual iliary input, and one input has able gain setting.

ECIFICATIONS:
put 2 sets of 2 x RCA sockets
ain 150, 300, 600mV, 1V and 2V
utput 2 x RCA sockets
6020 .... **$23.95**



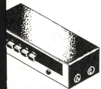
EAKER CONTROLLER (TAA801)

ables up to 5 pairs of stereo eakers to be switched on or off any combination.
ted at 50 watts continuous per annel.
ereo headphone socket ailable for private listening.
nstant minimum load circuit otects amplifier regardless of how any speakers are connected.
al circuit breaker protection.
. A16054 .... **$59.95**



EAKER CONTROLLER (TAA803)

bles 2 amplifiers (or TV & Amp) be switched to 4 pairs of eakers in any combination.
ed at 50 watts continuous per annel.
adphone output can be utilized hout interfering with the speaker.
nstant minimum load circuit tects amplifier regardless of v many speakers are connected.
h channel is protected parately by circuit breakers.
A16058 .... **$59.95**

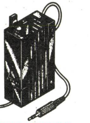


TAPE DIRECTOR (TAA802)

or those who do a lot of ng and recording. Features s for amplifier, auxiliary, 2 tape and 2 amplifier, 2 tape s, by simply selecting and ng the appropiate switch you le to:
ord from either tape unit while ning to another source ugh your system.
direct from tape 1 to tape hilst listening to tape 1 or 2
ord from auxiliary to tape 1 or 2 while listening to auxiliary ugh the amplifier
ord from amplifier to tape 1 or hile listening to the amplifier.
A16056 .... **$59.95**

ANTI VIBRATION ROPHONE HOLDER

pends microphones in an eight ion rubber mount.
nost standard body 25-30mm neter micrphones
dard 5/8" x 27 thread and to 3/8" reducer
65 .... **$15.95**



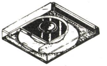
STEREO WIRELESS TRANSMITTER

This unit was developed to allow portable compact disc players to be used in cars by transmitting the headphone output signal directly in to your stereo FM car radio. It will also transmit any mono/stereo signal from any headphone output to any FM receiver.

SPECIFICATIONS:

- Input 3·5mm stereo phone plug. Impedance 32 ohm.
- Mono/stereo switch has plug mounting clip.
- FM Transmission approx. 90·35MHz (Tuneable 89-91MHz)
- Range 15 metres. (below 15mV/m at 100 metres)
- Power 1·5V AAA size batteries (100 hours continuous use)
- Size 72 x 38 x 21mm

A16100 .... **$69.95**



COMPACT DISC CLEANER

Even compact discs need to be kept clean otherwise the listening pleasure will be spoiled by drop outs or skips.

- Cabinet incorporates working base to place disc
- Soft suede cleaning pad (with pad cleaning brush)
- Spray which will gently loosen contaminents and not damage discs
- With disc cloth for handling discs
- Replacement cleaning pad and spray available separately

A10025 .... **$19.95**

COMPACT DISC CLEANER PAD & SOLUTION

Replacement pad and cleaning solution for to suit above. (A10025)
A10026 .... **$9.95**

ROTATING LIGHT

Motor driven rotating reflecting mirror with a flash rate of about 150 per minute. Large lens fit right to base, making unit weatherproof. Spare globe included.

SPECIFICATIONS:

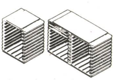
- Available in Blue or Orange
- 150 Revolutions per minute. (approximately)
- Shock absorbing rubber mounting legs
- Connecting wire fitted through base
- 12V DC 750mA
- Base diameter: 102mm
  Height: 140mm

A15042 Blue **$42.95**
A15043 Orange... **$42.95**

VIDEO/AUDIO TRANSMITTER

A small compact unit that allows transmission of video and audio signals (RF) to any TV set or VCR within a range of 30 metres (100"), simply by tuning in on Channel 11. Can be used as a transmitter for a video camera. With power on LED, on/off switch, audio and video leads and supplied with an AC adaptor.

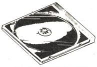
Transmission: VHF, channel 11 (PAL)
Video Input: 75 ohms, 1V p-p
Audio Input: 600 ohms
Output Control: Audio-video fine adjustment
Power Sources: 9V battery or power adaptor.
Accessories: RCA to RCA audio lead
RCA to BNC video lead
Size: 70(W) x 85(D) x 28(H)mm
Weight: 170 grams
A16150 .... **$69.95**



COMPACT DISC STORAGE UNITS

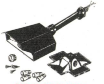
- Holds 10/20 compact discs in their cases
- Interlocking modular design allows vertical and horizontal interlocking
- Discs slide into place horizontally making titles easy to read.
- Wall mount or free standing.

A10031 (10 discs) **$12.95**
A10032 (20 discs) **$19.95**



COMPACT DISC CASE

Standard replacement compact disc case.
A10030 .... **$6.95**



PIR FLOODLIGHT

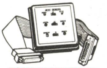
A perfect all night security device with dual element Passive Infra Red sensor. All weather outdoor operation. Features off, automatic, test and manual on at your wall switch. Complete with wall mounting bracket, cable terminations and instructions.

SPECIFICATIONS:
Detecting range: minimum 6 to 15 metres with variable control.
Detecting zones: 5 at 15° short, 12 at 8° medium, 12 at long range
Preset time: From 1 to 20 minutes with manual overide.
Photocell sensitivity: Activates circuit at about 2 footcandles, off at about 8 footcandles of light.
Positioning Adjustment: 2 ball joints allow free adjustment to suit area.
Relay output: Up to 500W of incandescent load only.
Power: 240V AC 50Hz
A15597 .... **$185**

RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket.
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC.
Jumper Wires: 20 tinned end pieces.
Power: Interface power.
Enclosure: Black, high impact plastic.
Dimensions: 85 x 95 x 30mm
X15700 .... **$94.95**



RS232 FAST CABLER

Makes RS232 interface configurating fast and simple. 3 slide switches enable line swapping functions, positive and negative voltages are displayed on 6 tricolour LED's.

SPECIFICATIONS:
Connector: DB25 plug on 100mm cable and DB25 socket on 100mm cable.
Indicators: Tricolour LED's for pins 2(TD), 3(RD), 4(RTS), 5(CTS), 6(DSR), 20(DTR).
Switches: 3 Slide switches to swap leads.
Power: Interface power.
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm
X15710 .... **$145**

U.S. 6 PIN TELEPHONE PLUG

- 6 slot, 4 pins wired
- Medium sized
- Crimp type

Cat.No.	1-9	10+
Y16006	**$2.75**	**$2.55**

U.S. 6 PIN TELEPHONE PLUG

- 6 slot, 6 pins wired
- Medium sized
- Crimp type

Cat.No.	1-9	10+
Y16007	**$3.25**	**$2.95**

4 PIN, 4 SLOT PCB MOUNTING U.S. PHONE SOCKET

- 4 Slot, 4 pins wired
- Small sized

Cat.No.	1-9	10+
Y16008	**$2.60**	**$2.40**

6 PIN, 6 SLOT PCB MOUNTING U.S. PHONE SOCKET

- 6 Slot, 6 pins wired
- Medium sized

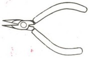
Cat.No.	1-9	10+
Y16009	**$2.95**	**$2.75**

BIG MOUTH CAR ALARM

FEATURES.....

- Easy installation
- Automatic on/off
- Loud alarm signal
- Auto reset
- Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx.
Entry Delay: 12 seconds approx.
Auto reset: 90 Seconds approx.
S15048 .... **$39.95**

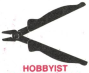


HOBBYIST LEAD NIPPERS

Great value for money! Perfect for the hobbyist.
T12055 (PP-1) **$6.95**

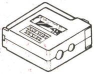
HOBBYIST SIDE CUTTERS

Value for money side cutters! Perfect for the hobbyist.
T12071 (PC-1) **$6.95**



HOBBYIST FLUSH CUTTERS

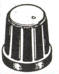
Great value for money! Perfect for the hobbyist.
T12074 (PC-2) **$6.95**



POCKET SIZE BATTERY TESTER

- Tests all 9V to 1·5V batteries including button cells.
- Arms extend to various battery sizes
- Easy to read meter.
- Requires no power source.

M23521 .... **$11.95**



NEW COLOUR KNOBS!

Standard metric fluted shaft with black dot marker and available in six different colours!

Dimensions: 17·2mm high.
12·8mm top diameter,
17mm bottom diameter.

Cat.No.	Colour	1-9	10+
H10070	Black	**$0.75**	**$0.65**
H10071	Blue	**$0.75**	**$0.65**
H10072	Green	**$0.75**	**$0.65**
H10073	Grey	**$0.75**	**$0.65**
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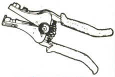
H10075	Yellow	**$0.75**	**$0.65**

MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces.
- Ideal for holding components, and other small/light objects.

Cat.T12458 ... **only $5.45**



AUTOMATIC CABLE STRIPPER

- Strips cable with diameter of 1 1·6 2 2·6 3·2mm
- Fully automatic action. Squeeze grip will simulataneously strip and eject insulation.
- Length 180mm (7")

T11532 .... **$19.95**

6 WAY U.S. TELEPHONE CABLE (W11332)

- 6 conductors, 7 strands. 0·16mm
- Conductor insulated O.D. 1mm
- Sheath cream P.V.C.
- O.D. 7 x 2·5mm

1-9 metres	10+metres
$0.90/m	**$0.75/m**

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Exclusive news story:

Australian hi-tech manufacturer forced to sell factory to Singapore

In a shock move, one of Australia's most successful small electronics manufacturers and exporters has been forced to sell all of its factory plant and bulging export order book to an entrepreneur in Singapore. Australia has now lost nearly 70 jobs and projected export earnings of over $12 million a year — plus a very promising centre for true hi-tech manufacturing.

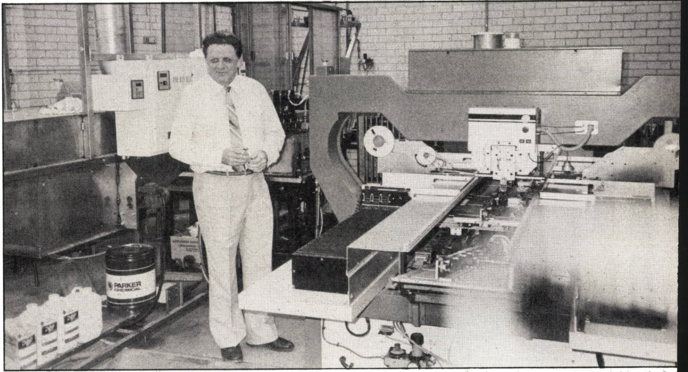
by JIM ROWE

In February this year, I visited a company whose business was the design and manufacture of microprocessor-based electronic controllers for domestic appliances — things like irons, toasters, washing machines, mixers, blenders, coffee makers and so on. The firm's controllers are used by a majority of the "big name" major appliance makers in the USA, Singapore and Europe: most of the well-known names, in fact.

The company was very successful, and had installed high-capacity automated production equipment for the latest SMD (surface-mounted device) technology, to achieve the efficiency necessary to compete in the world's markets, and the throughput necessary to deliver its orders on time. Walking through its production plant in Februar I couldn't help but be impressed wit the automatic pick-and-place machine loading 20,000 electronic component per hour.

Not only this, but the company ha designed its own specialised IC chips and had them made for it by leadin silicon foundries like TI, SGS, Hitachi NEC and Thomson-CSF. The chips ar rived in wafer form directly from th foundry, and were then bonded directl to the firm's own PC boards using th very latest automatic die bonding an wire bonding equipment — capable o processing 5000 chips per shift. Ver impressive indeed.

Of course it also had a well-equippe lab, with a staff of highly trained eng



ACS founder and MD Laurie Larsen standing between the company's Dynapert MPS500 automated SMD pick-and-plac machine (right) and Electrovert wave solderer, just before they were shipped off to Singapore. A sad day indeed . . .

neers using the latest computer aided design tools, to develop the firm's designs and back up the manufacturing plant.

Now then — where do you think this innovative, pioneering, efficient and world competitive electronics firm was located — in California's Silicon Valley? In one of Taiwan's science-based industrial parks? In Japan? In Singapore?

No, none of these. Believe it or not, it was in Revesby, an unassuming suburb in the western suburbs of Sydney — right here in Australia!

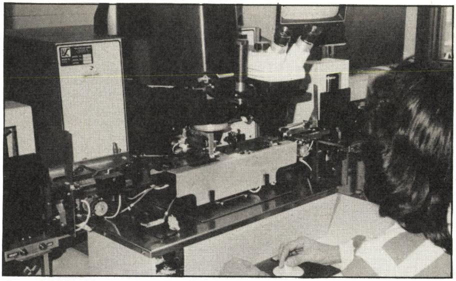
The company was Appliance Control Systems, and if you've never heard of it before, you wouldn't be alone. It was still almost unknown in its own country, even though overseas it was (and still is) regarded as one of the leading international designers and manufacturers of state-of-the-art appliance controllers. Only a few months ago it was exporting around $500,000 worth of controllers per month — not bad at all for an "unknown" little Aussie company!

But now (late July) I've just been back to ACS again, and it's a dramatically different story. All of that hi-tech manufacturing plant is now idle, waiting o be packed into crates for shipment to Singapore. Most of the 80-odd employees have also had to be put off, with the emaining people due to finish off at the end of the week. ACS the promising, dynamic and internationally competitive electronics exporter is no more.

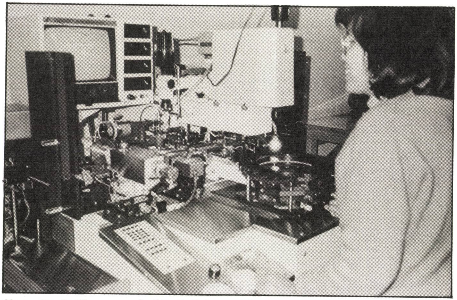
What happened? How could such a uccessful company, with a bulging rder book and terrific export potential – one that was virtually a model for Australian hi-tech manufacturing, go own the shute so quickly? To find out spoke to Laurie Larsen, the founder nd managing director of the company, who with his son Greg was the driving orce behind its growth.

Laurie was chief engineer for EMI Military Electronics for many years. He's a very experienced and talented ngineer, but also one of those rare people who's also a pretty astute businessman. Until late last year, he and reg had guided ACS very capably rough the maze of business plans, ash flows, materials scheduling and asing of manufacturing plant.

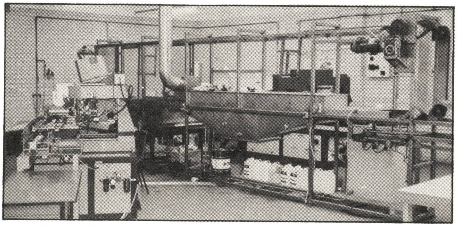
It had been that astute business sense at had led him to set up ACS in the rst place. After leaving EMI, he beme a design consultant, and found mself called in to help one or two apiance manufacturers whose in-house gineers were having difficulties degning new models. Like most appli-



One of ACS's highly trained people checks operation of its state-of-the-art Kulicke and Soffa 1470 automatic wire bonding machine. It has now gone, too.



Now also in Singapore is this Kulicke and Soffa 6300 auto die bonding machine, which took chips direct from the wafer and bonded them to PCBs.



As well as the Dynapert MPS500, ACS also had an Amistar SM1000 automatic SMD pick-and-place machine, shown at left above with the wave solderer to the right. Total assembly capacity was an impressive 20,000 component placings per hour.

ance designers, they had "cut their teeth" in the era of solenoids, relay contactors, cam sequencers and electromagnetic clutches; the transition to modern electronics and microprocessor controls didn't come easily.

It didn't take long for Laurie to discover that appliance makers around the world were all having the same sort of problems. There was obviously an opening there, for an innovative designer who could combine a good knowledge of modern electronics with a sound understanding of appliances. And so Appliance Control Systems was born.

Right from the start, it became obvious that because of the appliance makers' lack of experience with electronics, ACS would need to provide a "turnkey" design service. In other words, it wasn't sufficient simply to design an electronics control module for some new appliance, and then expect the appliance manufacturer's own engineers to work out how it could be integrated with the rest of the product. It was necessary to produce a complete design package, covering the total integrated product — including manufacturing plans.

It also became clear that the appliance makers generally weren't equipped to manufacture the electronic controllers themselves, even after they had been designed. They could generally make the rest of the appliances, but not the electronics.

So ACS soon found itself getting into manufacture as well as design — and high volume cost-efficient manufacture at that. The world's appliance market is highly competitive, and every cent counts when it comes to the cost. The electronics in a controller module must combine very high reliability with the lowest possible price — the ultimate engineering challenge!

But to become really efficient and cost competitive at high-volume manufacture, it was necessary to invest in the latest SMD assembly machinery, and in die and wire bonding machines. And so it was that towards the end of last year, ACS had to explore ways to raise the appropriate capital.

Being sensible businessmen, and aware that they weren't too experienced in high finance, Laurie and Greg sought advice from the experts. And with the benefit of hindsight, here's where the seeds of disaster started to be sown.

By the way, I'll have to be rather coy here about the names of the financial institutions, merchant banks, stockbrokers and so on that were involved, for reasons that should become obvious.

The initial advice from a certain highly-respected commercial bank was to acquire a defunct public company, to facilitate listing on the second board of the Sydney Stock Exchange. But when the recommended company was purchased, it turned out to have unexpected problems — like "forgotten" shareholders who suddenly appeare out of the woodwork, and a large out standing debt (which by sheer coinci dence, happened to be owing to a sub sidiary of a certain highly-respecte commercial bank . . .).

Then an equally highly respecte stockbroking and underwriting firm wa consulted, for its advice and help o listing. Their advice was initially to lis in late 1986, and invite public subscrip tion for 30% of the company's shares.

But then the executives at the stock broking firm who were handling th project were fired. Other executive were assigned, but plans for the publ listing started to slow down.

Of course a manufacturer can't ju keep on delaying plans for getting e sential manufacturing plant — or the o ders may go elsewhere. So the stoc broking firm advised getting a bar loan to allow things to proceed in t meantime, and guaranteed the loan.

Then the advice started to chang Rather than list, it would be better raise the required capital by placi stock privately with two investme companies. This seemed to have adva tages, so the new advice was taken. T shares were sold, and the investme companies invited to appoint direct to the ACS board (or strictly the Ma Resources board, for that was the ho ing company that had been acquired that purpose).

Then things became even less am ing. Despite all the high-powered fina cial advice, the actual amount of capi raised by the sale of shares to the t investment companies turned out to rather small, after the various expen and fees had been deducted — list fees, stockbroker's advice fees, und writing fees and so on. In fact there very little left — sorry about that! Af all, you did want really professional vice . . .

But not to worry — one of the inve ment companies would provide m funds to finance the growth, by tak more equity. By then, of course, th

Hunt the oceans instead of the classifieds.

As an Airborne Electronics Analyst in the RAAF, you'll fly in a P3C Orion Maritime Surveillance aircraft, sweeping the oceans in search of "friend or foe" submarines and ships.

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AIRBORNE ELECTRONICS ANALYST RAAF

Authorised by the Dept. of Defence.

AFAC203.QP.77A

The last few ACS employees work at finishing off the final run of appliance controller to go through the factory, before everything was packed up for shipping to Singapore. Two days later they had to be put off, although a small number went to Singapore with the machinery, to train staff.

wasn't much option; it was either go ahead, or call it a day. So things went ahead. By now the Larsens' shareholding in Macro Resources/ACS had been whittled down from about 80% to less than 30%, and the company was more in hock than ever before . . .

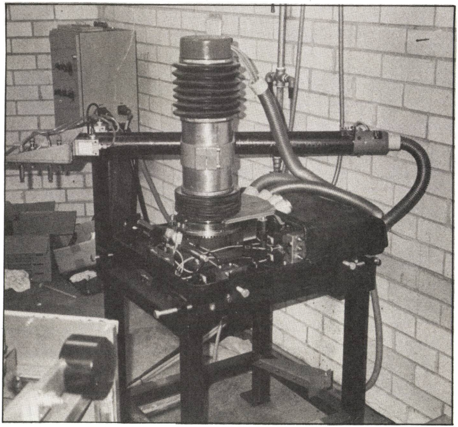
Then a month or two down the track, one of the investment company directors announced at a board meeting that his company could no longer afford to support ACS and its debt. Almost before you could say "appliance controllers", one of the banks had placed ACS into receivership. They weren't willing to wait until ACS could meet some of those orders, ship some controllers and trade out of its debts.

All that could be done was to seek a buyer for the manufacturing plant — and that buyer happened to be Mr Mathew Goh, the very successful Singapore-based entrepreneur. Needless to say Mr Goh had no trouble finding investors in Singapore to finance the deal. Nor did he have any shortage of help from the Singapore Government, in the way of things like tax concessions or grants to cover training of people in Singapore by ACS's experts. They're keen to nurture manufacturing, in developing countries . . .

The nett result is that ACS is gone, and Australia has lost yet another really promising hi-tech manufacturing company. All those orders are now going to be met by Mr Goh's company in Singapore, using the technology developed here by Laurie Larsen before he sought dvice from the professionals.

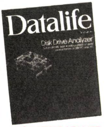
Mr Goh has been able to acquire a good investment: a complete hi-tech electronics plant, plus a healthy order book to match. Good luck to him. But it makes you wonder, when a so-called "developed" country like Australia can't nurture its manufacturing industries, and they have to be sold off to a "developing" country like Singapore. If I were Mr Goh, I'd find this pretty ironic.

As for Laurie and Greg Larsen, they haven't given up. They're hoping to set up a new company, to continue the innovative R&D work that they began at ACS. But this time, they'll be staying well clear of the money lenders.



Even this cute little ASEA robot arm went to Singapore, too. It had the boring job of transferring PCBs to the wave soldering line.

SAVE ON PERIPHERALS AT



VERBATIM DATALIFE DISK DRIVE ANALYZER

Disk drives are delicate instruments. And when they get out of adjustment, the integrity of your data is jeopardized.

With the Datalife Disk Drive Analyzer, you will know the exact condition and accuracy of your drives and avoid losing or damaging your valuable data.

Tests 4 critical areas...
In just minutes, the Datalife Disk Analyzer tests your drives' radial alignment, speed, write/read ability and clamping accuracy. And for each of these areas, it analyzes whether your disk drive is in good condition, fair condition or might need service.

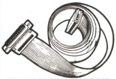
If service is required, you can also use the Disk Drive Analyzer afterwards to ensure that the work was done properly.

No technical knowledge or special tools needed...
Everything you need is in this package. All you do is place the preprogrammed Disk Drive Analyzer in the drive to be tested, and select from the display screen menu the test or tests you want. And you can perform each test separately or have them all run automatically in just minutes.

Your data is worth protecting...
Your flexible disks represent a valuable investment of time and money. The data they carry may be difficult or time consuming to replace. That's why it's vital to know the exact condition of your drives.

With the Datalife Disk Analyzer, that's a quick and easy task. If you value your data, you can't afford to be without it.

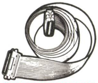
C12525 IBM* PC/XT **$59.95**
C12530 Apple* **$59.95**



IBM* FLOPPY DISK DRIVE EXTENSION CABLE

- DB37 Male to 34 way edge connector
- Length 0·5 metres

P19045 .... **$95**



36 WAY CENTRONICS CABLES

- Male to male connections.
- All 36 pins wired straight through.

P19042 2 metre **$19.95**
P19040 6 metre **$29.95**

RS232 DIP SWITCH LEAD

- 10 Way Dip Switch
- DB25 male plug to DB25 male plug
- Length: 2 metres
- Instructions included

Cat. P19031 .... **$59.95**

2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

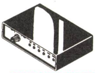
2 WAY Cat.X19120 **only $89**
4 WAY Cat.X19125 **only $99**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics, Star, and many other printer manufacturers.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY (X19130) .... **only $89**
4 WAY (X19135) .... **only $99**



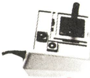
RS232 DATA SWITCH WITH TESTER

- No power required
- Ideal for 1 computer to 2 peripherals or 2 computers to one peripheral.
- 25 pin RS232 "D" connectors,
- Six dual coloured LED indicators showing certain flow status:

T.D. Transmit Data
R.D. Receive Data
R.T.S. Request To Send
C.T.S. Slear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready

- Size: 200(W) x 68(H) x 150(D)mm

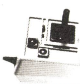
Cat.X19110 .... **R.R.P. $169**
Our Price $149



APPLE* COMPATIBLE JOYSTICK

Ideal for games or word processing. Fits most 6502 "compatible" computers.

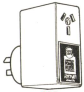
Cat. C14200 .... **$39.95**



APPLE* II SERIES COMPATIBLE JOYSTICK

These joysticks have adaptor connectors to suit the Apple II, IIc, IIe and II+ computers. Features include selectable "spring centring" or "free floating". Electrical trim adjustments on both axis, 360° cursor control and dual fire buttons

Cat. C14201 .... **only $39.95**



CPF CONTINUOUS POWER FILTER SPIKE ARRESTOR

The Fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers, printers, telephone systems and modems electronic typewriters, audio and stereo systems and other sensitive electronic equipment.

The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life.

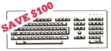
CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.

Additionally, CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors, fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components.

SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4,500 amps for 20m/second pulses.
Maximum clamping voltage: 275V differential mode.

Cat.X10088 .... **$69.95**

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

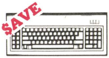


IBM* XT & AT COMPATIBLE EXTENDED KEYBOARD (105 KEYS)

These new keyboards are both XT and AT compatible!

- 20 Dedicated function keys
- Enlarged "Return" and "Shift" key
- Positive feel keys
- Low Profile Design, DIN standard
- Separate Numeric and Cursor control keypads
- Additional Functions...
  Key-in-lock, Audio Beep, Previous Word, Next Work, Fast Repeat, Line Feed, Pause, Clear Screen, Reset.

Cat.X12022 .... **WAS $299**
SPECIAL, ONLY $199



"IBM* AT COMPATIBLE" KEYBOARD

- 100% IBM* PC, XT compatible
- Low profile keyboard design
- Proper placement of shift keys with large key tops to suit professional typists.
- 3 step height/angle adjustment
- Cherry brand TS-M00001 19mm low profile switches, meet 30mm ergonomic requirement and provides high performance and maximum reliability.
- Curl lead plugs straight into PC/XT
- 3 Status displays

Just like the "Real McCoy" only at a fraction of the price!

Cat.X12020 .... **only $129**

JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...

- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

C16020 .... **only $24.95**
C16027 (Hinged Lid) **$26.95**

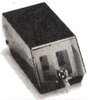
5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...

- 70 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

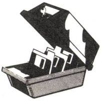
Cat. C16025 .... **only $19.95**



3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes.
- Lockable (2 keys supplied)
- High impact plastic lid and base
- Anti static

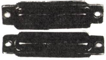
Cat. C16040 .... **only $19.95**



3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes.
- Lockable (2 keys supplied)
- High impact plastic lid and base

Cat. C16035 .... **only $19.95**



DB25 CONNECTOR SPECIALS!

We have just imported 50,000. So you get to save a small fortune!

DB25 MALE (P10900)

1-9	10+	100+
$1.00	**$0.90**	**$0.80**

DB25 FEMALE (P10901)

1-9	10+	100+
$1.20	**$1.00**	**$0.90**

RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket.
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC.
Jumper Wires: 20 tinned end pieces.
Power: Interface power.
Enclosure: Black, high impact plastic.
Dimensions: 85 x 95 x 30mm

X15700 .... **$94.95**

RS232 FAST CABLER

Makes RS232 interface configurating fast and simple. 3 slide switches enable line swapping functions, positive and negative voltages are displayed on 6 tricolour LED's.

SPECIFICATIONS:
Connector: DB25 plug on 100mm cable and DB25 socket on 100mm cable.
Indicators: Tricolour LED's for pins 2(TD), 3(RD), 4(RTS), 5(CTS), 6(DSR), 20(DTR).
Switches: 3 Slide switches to swap leads.
Power: Interface power.
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm

X15710 .... **$145**

SEMICONDUCTORS!

Always check our prices before you buy!

	1-9	10+	100+
2114	**$2.95**	**$2.75**	**$2.50**
2716	**$9.95**	**$9.50**	**$8.95**
2732	**$8.95**	**$8.50**	**$7.95**
2764	**$7.95**	**$7.50**	**$6.95**
27128	**$9.95**	**$8.95**	**$7.95**
27256	**$11.50**	**$10.50**	**$10.00**
27512	**$19.50**	**$18.50**	**$17.50**
4116	**$3.95**	**$3.50**	**$2.95**
4164	**$3.95**	**$2.95**	**$2.75**
41256	**$7.95**	**$6.95**	**$5.95**
555 8pin	**$0.50**	**$0.40**	**$0.35**
6116	**$3.95**	**$3.75**	**$3.50**
6264	**$7.95**	**$6.95**	**$6.50**
6802	**$5.00**	**$4.00**	**$3.75**
6821	**$2.00**	**$1.80**	**$1.70**
6845	**$5.00**	**$4.00**	**$3.75**
7406	**$0.40**	**$0.30**	**$0.25**
INS8250	**$29.95**	**$27.95**	

NE5534AN

SCOOP PURCHASE!!!

1-9	10+	100+
$1.95	**$1.85**	**$1.75**

WORLD MODEM CHIP

Cat. U21614 .... Normally $49.50
Save $25, SPECIAL $24.95

MEL9501

Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing boards? We have the MEL9501 chip!

SPECIAL, ONLY $29.95

8087

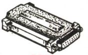
Genuine Intel chips with manual and data sheets packed in boxes!

8087-3 (4.77MHz)	**$269**
8087-2 (8MHz)	**$385**
8087-1 (10MHz)	**$585**
80287-6 (6MHz)	**$475**
80287-7 (8MHz)	**$679**

DB9 GENDER CHANGERS

- Saves modifying or replacing non mating DB9 connections
- All 9 pins wired straight through

X15640: Male to male
X15641: Male to Female
X15642: Female to Female
.... **only $14.95**



DB15 GENDER CHANGERS

- Saves modifying or replacing non mating DB15 connections
- All 15 pins wired straight through

X15645: Male to male
X15646: Male to Female
X15647: Female to Female
.... **only $14.95**

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $14.95 eac
Only $9.9

RS232 INLINE SWITCHING BOX

- 25 pin "D" plug to 25 pin "D" socke
- DIP switches allow easy switchin of internal wiring.

Cat. X15662 .... **$32.9**

RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

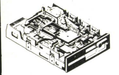
Cat. X15665 ...... **Normally $49.**
Only $44.9

CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight throug

Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**
Normally $33.9
Only $24.9

ROD IRVING ELECTRONICS!



NEC DISK DRIVES

3½" DISK DRIVE

- 1 M/Byte unformatted, (640K formatted),
- Double sided, double density,
- Access Time 3m/sec

Cat. **$265**

5¼" SLIMLINE

- Switchable 1.6 M/Byte to 1 M/Byte unformatted
  1.2 M/Byte to 720K formatted
- Double sided, double density,
- AT compatible

Cat. C11906 .... **$295**

8" SLIMLINE

- Double sided, double density,
- 1.6 M/Byte unformatted.

Cat. C11908 .... **$795**

IBM* COMPATIBLE DISK DRIVES

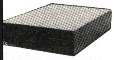
Tired of paying out more for Japanese Disk Drives? These "direct import" Hong Kong disk drives are the solution! They feature Japanese mechanical components, yet cost only a fraction of the price!

Cat.No.	Description	Price
C11801	500K	Normally $199 **SPECIAL, ONLY $179**
C11805	1.6 M/Byte	**$259**

20 M/BYTE HARD DISK DRIVE FOR IBM* AND COMPATIBLES

NEC drive with DTC controller card.
Cat. X20010 .... **WAS $995**
SPECIAL, ONLY $850

*IBM is a registered trade mark.



APPLE* COMPATIBLE SLIMLINE DISK DRIVE

Compatible with Apple 2+
Cat. X19901 .... Normally $225
SPECIAL $179

APPLE* IIC COMPATIBLE DISK DRIVE

Including cable .... **only $199**
(Apple is a registered trade mark.)

SWIVEL BASE

Make life easier with these quality, swivel and tilt bases, complete with rubber fittings!
Cat. D11100 .... **$29.50**

IBM* XT COMPATIBLE CARDS

NEW! NEW! NEW! NEW!

20M/BYTE HARD DISK CARD
XT compatible, simply plugs straight in to your computer!
Cat.X20020 .... **$1,095**

Colour Graphics Card
Cat. X18002 .... **$129**

Mono Graphics/Printer Card (Hercules compatible)
Cat. X18003 .... **$119**

Floppy Disk Drive Controller Card
(2 Drives, 16 Bit)
Cat. X18005 .... **$59**

Floppy Disk Drive Controller Card
(4 Drives, 16 Bit)
Cat. X18006 .... **$65**

High Resolution Mono Card
Cat. X18007 .... **$199**

Colour Graphics & Printer Card
Cat. X18010 .... **$149**

768kB RAM Card (without memory)
Cat. X18012 .... **$89**

Printer Card
Cat. X18017 .... **$34.95**

Game I/O Card
Cat. X18019 .... **$37.95**

XT Motherboard (without memory)
Cat. X18020 .... **$225**

Clock Card
Cat. X18024 .... **$57.50**

RS232 Card (without cable)
Cat. X18026 .... **$52.50**

RS232 & Clock Card
Cat. X18028 .... **$95**

XT Turbo Motherboard
8 MHz, without memory
Cat. X18030 .... **$245**

Multi I/O & Disk Controller Card
Cat. X18040 .... **$169**

I/O Plus Card
Cat. X18045 .... **$129**

768K Multifunction I/O Card
(includes cable but not 41256 RAM)
Cat. X18050 .... **$199**

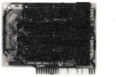
Hard Disk Controller Card
Cat. X18060 .... **$195**

Enhanced Graphics Adaptor Card
256K RAM on board
Cat. X18070 .... **$295**

64K Printer Buffer Card
Cat. **$139**

(AT COMPATIBLE)

Enhanced Graphics Adaptor Card
(Award Bios)
Cat. X **$495**



APPLE* COMPATIBLE CARDS

PRINTER CARD
Cat. X17029 .... **$89**

DRIVE CARD
Cat. X17019 .... **$79**

80 COLUMN CARD
Cat. X17025 .... **$85**

SUPER SERIAL CARD
Cat. X17035 .... **$119**

RGB CARD
Cat. X17039 .... **$79**

PAL COLOUR CARD
Cat. X17027 .... **$95**

Z80 C/M CARD
Cat. X17041 .... **$59**

APPLE* IIe COMPATIBLE CARDS

80 COLUMN/64K CARD
Cat. X **$99**

64K/128K CARD
Cat. X **$99**

PRINTER LEAD FOR IBM*

- Suits IBM* PC XT and compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug

Cat.P19029 1.8 metres . **$17.95**
Cat.P19030 3 metres **$22.95**

SAMSUNG 12" 20MHz COMPOSITE MONITOR ONLY $149

FEATURES....

- High contrast, non-glare screen
- High resolution, 80 or 40 character display

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green (P39) or Amber
Video input signal: Composite Signal
Polarity: Negative Sync.
Level: 0·5V-2·0Vp-p
Scanning frequency:
Horizontal: 15.734 KHz + −0·1%
Vertical: 60Hz
Video bandwidth: 20MHz
Active display area:
216(H) x 160(V)mm.
Display character:
80 characters x 25 rows.
Input terminal: RCA Phono Jack
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size.
Inside: H-Width, H/V hold, H/V linearity, Focus.
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Dimensions:
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Weight: 7·3 Kg
Shipping weight: 8·3 Kg

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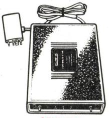

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- High contrast, non-glare screen
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SPECIFICATIONS:
Picture tube: 12" diagonal 90° deflection
Mode: TTL
TTL input signal:
Polarity: TTL Positive
Level: 4V p-p + −1·5V
Impedance: 75ohm
Video bandwidth: 16MHz (−3dB)
Scanning frequency:
Horizontal: 18·432 + −0·1KHz
Vertical: 50HZ + −0·5%
Active display area:
216(H) x 160(V)mm
Display characters:
80 characters x 25 lines
Input connector: 9 pin connector
Controls:
Front; Power ON/OFF, Contrast.
Rear; V-Hold, V-Size, Brightness
Internal; Vertical Linearity, Horizontal Linearity, Horizontal Width, Focus.
Power supply: 110/120V 60Hz, 220/240V 50 Hz
Dimensions:
308(W) x 297(H) x 307(L)mm
Weight: 7·3Kg
Shipping weight: 8·3Kg

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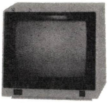

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Video Signal: Separate video signal
Video: Positive
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Vertical: 60Hz
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Horizontal: 640 dots
Vertical: 200 lines
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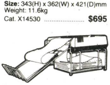

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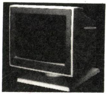

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FEATURES....

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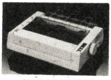
- High resolution, 80 or 40 character display
- Swivel/Tilt base

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Green (P42)
Video input signal: Composite/TTL Switchable
Polarity: Negative/Positive
Level: 0·5 - 2·0Vp-p/4·0+ −1·5Vp-p
Impedance: 75ohm, more than 6·8K ohm
Scanning frequency:
Horizontal: 15.75 KHz + −0·1%/18·432KHz+ −0·1%
Vertical: 47-63Hz
Video bandwidth: 20MHz
Active display area:
Composite: 206(H) x 160(V)mm.
TTL: 216(H) x 160(V)mm
Display character:
80 characters x 25 rows.
Input terminal: Phono Pin Jack, 9 pin D-Sub Connector.
Controls:
Outside: Power Switch, Contrast, Brightness, Signal Select, V-Hold, V-Size.
Inside: H-Width, H/V linearity, Focus, H/V-Shift.
Power supply: 110/120V 60Hz, 220/240V 50Hz
Dimensions:
308(W) x 297(H) x 307(L)mm
Weight: 7·3 Kg
Shipping weight: 8·3 Kg

Cat.No.	Description	Price
X14509	(GREEN)	**$239**



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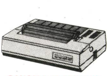

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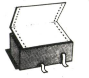

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FEATURES....

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- Tilt/swivel base
- Compatible with Apple* and IBM* colour composite signal

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green or Amber
Video input signal: Composite Signal
Polarity: Negative Sync
Level: 0·5-2·0Vp-p
Impedance: 75ohm
Scanning frequency:
Horizontal: 15.734 KHz + −0·1%
Vertical: 50-60Hz
Video bandwidth: 20MHz
Active display area:
216(H) x 160(V)mm.
Display character:
80 character x 24 rows.
Input terminal: RCA Phono Jack.
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size.
Inside: H-Width, H/V hold, H/V linearity, Focus.
Power supply: 110/120V 60Hz, 220/240V 50Hz
Dimensions:
310(W) x 307(H) x 300(L)mm
Weight: 8·1 Kg
Shipping weight: 9·6 Kg

Cat.No.	Description	Price
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FORUM

Conducted by Neville Williams

CD error correction: Is quality at risk?

On page 19 of the April issue, I posed a somewhat tongue-in-cheek question which could well be re-phrased thus: Is it conceivable that CD error correction circuitry, while ostensibly concealing certain data faults might, in fact, be translating them into incongruous components which can be perceived as such by keen-eared listeners?

In the particular article, I had made the point that supporters of the traditional analog system were tending nowadays, to disregard the fact that most modern black discs are sourced from digital master tapes. Yet many of them maintain their opposition to compact discs on the grounds that the digital technology, on which they are based, renders them discernably "un-musical".

Whatever the term means, it invites some clarification as to why digital technology should be okay for studio mastering but unacceptable for consumer-level products.

With no such explanation forthcoming, I offered to invent one, based on the fact that most modern digital master recorders (e.g. the DASH format) allocate two or more tracks to each channel, with instantaneous automatic track switching in the event of a data fault being encountered.

With tongue planted firmly in cheek, I pointed out that, by contrast, the CD system relies on a single data stream to serve both channels. It is backed up, however, by powerful error correction circuitry, capable of correcting or concealing discontinuities in the data stream that might otherwise be heard as clicks or plops.

"Could it be", I asked, "that CD technology relies too heavily on correction circuitry, particularly in the case of discs and/or players with more than their fair share of data stream errors?"

Is it possible that, in the process of concealing an excessive number of errors, it also conceals (or otherwise processes) an excessive quota of high frequency signal information — thereby imparting that allegedly incongruous, unmusical quality to the sounds?" (My dictionary tells me that, amongst other things, incongruous means "not harmonious in character").

Not long to wait

While stressing that the suggestion lacked "any known basis in fact", I nevertheless wondered privately how long it would be before someone else adopted the idea or, alternatively, came up with it independently. I didn't have long to wait.

In the "Views" page of the May 1987 issue of "Hifi News & Record Review", a correspondent (R.Webb, London) had this to say on the matter:

"It seems that if your CD player has a touch of the "jitters" or any other vibrational problem of focussing on the data information, then the CIRC or error corrections fabricates a mean average of what's missing.

"If this is happening regularly and every so often in each code word (as is likely with a wobbly disc or chassis vibration) then I'm not surprised if the sound is "less sweet" with "a lessening of the sound stage" when a disc is used without a Mod Squad Damper Kit . . . since it's the definition of the faster frequencies that will be hardest hit.

" . . . manufacturers should look into giving us an indication of what percentage of the music we are hearing is "correct" and what is "made up" . . . How about one of those simulated voice chips, which waits until you've removed the disc from the player and then states . . . 50% of what you've been listening to was guessed by the computer inside this player!"

R.Webb certainly doesn't theorise by halves, beginning, as he does, with pure speculation and ending up with an implication — even if consciously exaggerated — that 50% of what we hear from a CD player could be computer guesswork. I do concede, however, that exaggerated or not, the suggestion has about it a certain credibility and that, somewhere down the track, it will need to be investigated and quantified in relation to typical present-day discs and players.

Published claims

While I have no doubt that relevant figures already exist in laboratory notes and limited circulation research papers, up-to-date information is very patchy indeed as far as consumer level authors and publications are concerned.

Some suggest that this is no accident that manufacturers see little point in un settling their one reasonably prosperou market area with gratuitous technica debate; it is sufficient to maintain tha the CD system employs powerful erro detection and correction technology able to ensure a smooth flow of sound free from distortion and unmarred b dropouts and clicks.

For the more technically minded, has long since been identified as th Cross-Interleave Reed-Solomon Cod (CIRC) which, as per the original spec fications, makes possible "complete co rection" of errors spread over 4000 bi — equivalent to a 2.5mm section of p track. This can take care of:

- Random errors — involving relativel isolated bits, caused in disc productio by inaccurate photo resist coating, or b other minute blemishes, and
- Burst errors — resulting from visibl

scratches and fingerprints on the disc surface.

Over and above that, according to the specifications, CIRC is capable of reconstituting more extensive losses of up to 12,300 bits, by adjacent sample interpolation, equivalent to 7.7mm of track length. Beyond that again, the system mutes the channel rather than et through a burst of noises.

For those inclined to tackle it, the theory behind such claims is well documented in academic literature. Alternatively, in his helpful book "Principles of Digital Audio" (Howard W. Sams & Co. Inc) Ken Pohlmann explains the basic principles of error correction in more readable form but, even so, don't expect to take it in over a casual cup of morning coffee!

In their early CD literature, Technics claimed to have developed an original Super Decoding Algorithm "so advanced that the chances of being able to retrieve the correct data are an incredible once in 5000 years".

About the same time, Sony published a graph showing the performance of their own "Super Strategy" restoration method. The "Probability of Detection and Compensation Error (data word)" axis was calibrated all the way from 1 Word/Minute to 1 Word/10,000 years!

It is intriguing to speculate how the respective companies could have arrived at such odds and what they really amount to in practice. But the 4000-plus year time-frame certainly made for eye-catching headlines when the CD system was first announced!

Apart from anything else, it is one thing to restore or conceal aberrations in a data stream. It could be — and is — quite another to maintain proper tracking when segments of the microscopic data spiral are obscured by scratches or fingerprints. An entirely different circuit function is involved.

The decoding circuitry?

To unscramble the digital data and ecover the discrete left and right audio hannel information, all CD players ust obviously incorporate processing omplementary to the basic architecture f the encoding system. And, because it ncludes CIRC error correction, it is ften assumed that all CD players incororate essentially similar circuitry to deect, correct and/or conceal errors.

But here we get into a distinctly grey rea, with everyone listing CIRC error orrection in their specification, some nvoking fancy terminology but none dmitting to — or being accused of — utting cost in this area.

Ken Pohmann says, however: "Not all CD players are alike in terms of error protection. Any CD player's error protection ability is limited to the success of the strategy chosen to decode the CIRC data on the disc and perform concealment".

According to Technics: "Many error correction systems are employed, from the very simple to the extremely complex". Sony's graph, mentioned earlier, contrasted their own "Super Strategy" with a "standard error correction system" and a "simplified error correction system".

But who uses which, in currently available players, and to what effect? I'd hate to be holding my breath, awaiting the answer!

Other interesting figures:

A couple of readers' letters, referring to earlier discussion of 4-channel compact discs, included photostats which served to confirm that the 4-channel mode did receive early mention. But the photostats happened also to carry information on "BER" — a term that is subject to some confusion but which can usually be taken to mean "Bit Error Rate".

The following figures, listed in the Philips Technical Review Vol 40/6, appear to agree with those in an early Sony publication credited to Nakajima, Fukuor and Iga. (For the references, I am indebted respectively to A.J. of City Beach, WA and to R.P. of Point Frederick, NSW).

- Maximum completely correctable burst length: 4000 bits (2.5mm track length)
- Maximum interpolatable burst length in the worst case: 12,300 bits (7.7mm)
- Sample interpolation rate:

1 per 10 hours at BER = 10^{-4}
1000 per minute at BER = 10^{-3}

- Undetected error samples (clicks):

Less than 1 every 750 hours at BER = 10^{-3}
Negligible at BER = 10^{-4} or greater

Based on what has been said to this point, I would discount the proposition as originally put forward by R.Webb of London, on the grounds that isolated data errors appearing in individual words are (a) unlikely and (b) completely correctable, therefore non-existent at the D/A converter input.

His proposition, like mine in the April issue of EA, would more likely relate to what Sony describe as an "unfavourable" situation where, as listed above, the " raw" bit error rate (i.e. as read off disc) averages 10^{-3} (one incorrectly recorded bit in every 10^3 or 1000), and where the sample interpolation rate may get up to around 1000/-minute.

The figures would suggest extensive scratches or finger marks on the surface of the disc, sufficient to defy digital redundancy correction and to "flag" at least a couple of major burst errors per revolution, requiring interpolation.

Provided tracking was maintained, they would still not create a significant click problem (one click every 750 hours?) although "bush" logic might well insist that all those interpolations — all that computer guesswork — must somehow prejudice quality.

But before proceeding to that conclusion, let's get certain things into perspective.

BIT ERROR RATE: As already mentioned, BER = 10^{-3} represents very "unfavourable" playing conditions, conceivable with people who are careless with their discs but scarcely applicable to those concerned with a quality result. But even 1000 interpolated (computer guessed) samples is a very small number compared with the 5,000,000-odd audio samples pouring down the data stream at 2 x 44.1 thousand samples per second. BER figures are admittedly ambiguous but anyway you care to interpret them, the interpolated samples add up to a tiny fraction of 1% — a far cry from R.Webb's 50%.

BER = 10^{-4} is more typical, with the interpolation rate falling to virtually zero.

Ken Pohlmann, quoted earlier, has this to say on the same subject:

"Theoretically, the raw bit error rate on a CD is between 10^{-5} and 10^{-6}, that is there is one incorrectly recorded bit for every 10^5 (100,000) to 10^5 (1 million) bits on a disc . . . In practice, because of the data density, even a mildly defective disc can exhibit a much higher bit error rate".

What do customers say?

While the above figures tend to discount the "interpolation distortion" concept, they do not necessarily reflect everyday experience with current discs and current model players. So I sought a few reactions.

In a large department store, I explained to the lady behind the record sales counter that I was writing an article on the general subject of compact discs and had been wondering whether they received many complaints about quality. She was obviously puzzled as to why such a question should arise. Customers seemed very happy with the discs, she said. They certainly keep coming back for more!

The manager of a large specialist music store was somewhat more analytical. Complaints were few and far between but, yes, he could remember the odd occasion.

Did the complaints have to do with sound quality or tracking problems?

"Mainly tracking problems," he said, "and apparently justified because the discs didn't track too well on our shop player either. We simply replaced them with a new pressing and that was the end of the matter."

Perhaps more to the point:

"We get occasional complaints about all recordings . . . black discs and tapes as well. My impression is the CD's are better than average, not worse!"

Another man with a technical background told me of a friend whose CD player was equipped with a LED indicator which flashed whenever it had processed a major fault — presumably when the error processing logic had flagged "uncorrectable — interpolate".

His friend had said that he could usually pick a record that had more than its share of data errors. When I asked about the 1000 errors-a-minute rate, that sort of figure had apparently not even been considered.

"Good heavens. The LED'd be on all the time!"

Maybe others with access to a similar player could enlarge upon these observations.

In the meantime, I come back to that BER = 10^{-3} figure, representing interpolations equal to a tiny fraction of 1%. If we discount the fact that interpolations are "educated" computer guesses and regard them as totally incongruous distortion components, they would still only constitute a tiny fraction of 1% — and that's less identifiable distortion than one would expect from an FM transmission, a black disc player or a loudspeaker system.

In saying that, I've just completed the full circle, with tongue firmly back in cheek and a conviction that interpolation distortion is exactly what it started out to be: a "phurphy"!

Self-adhesive quality!

While in the general subject of compact discs, I have to hand a letter from D.H. of Waterloo, NSW. After saying how much he enjoyed the dissertation on the "golden ear" brigade in April, he feels that they are about to be upstaged by the "flashed platinum eared" group. As evidence of this, he encloses a clipping from the "Western Mail" newspaper (March 21-22, page 3) in which the writer says that a self-adhesive plastic foil, pasted on the label side, can improve the sound from compact discs.

According to the Western Mail writer, compact discs pose a problem in that they are both valuable and small enough to be slipped into a pocket by a light-fingered visitor. Discs can be "personalised" by lightly engraving or marking the label side only with a felt pen, but ink marks may prove to be erasable. Sticking bits of paper to the disc is not a good idea, either, "because they can come off and get caught up in the works".

The preferred approach, according to the Western Mail, is to mark the label side with a felt pen and then to paste over the side a self-adhesive plastic foil "damper", available from most hifi stores for $5 for a pack of five. It will protect the ink from erasure and "will improve your sound at the same time".

To be frank, I have never seen these plastic dampers, nor have I felt the need for them. To the best of my knowledge, none of the "friends" who visit my house are of the light-fingered kind, anyway.

But frankly, I'm not enamoured with the idea of pasting a foreign coating on the surface of my compact discs. If it's very thin, I fail to see how it could do much for acoustic damping. But, if its suitably thick and heavy, I would be concerned about the possibility of it being positioned sufficiently off-centre to prejudice balance and promote vibration at 500rpm.

And what of its long-term chemical and physical properties? Are they completely compatible with those of the disc or might they ultimately set up stresses with possible warping. I'm afraid that, like D.H., I am not anxious to join the "many people" who are said to be "working through their collection of discs, gradually treating them with the coating".

Damping problems

A.J. of City Beach, W.A., to whom I referred earlier, also expresses little sympathy for the "golden-ear brigade", but in the context of super-heavy loudspeaker cables. He makes the point that extreme electrical damping is neither necessary with well designed loudspeakers, nor is it attainable by simply using heavier cables, because voice resistance itself becomes the limiting factor. Says A.J.:

"If the super-cable addicts (or victims?) are dinkum, they'll have to buy loudspeakers with voice coils made of similar wire".

A.J. might be interested to learn that a pretentious American console receiver (Gulbransen, if I remember correctly) imported for the luxury market during the late '20's, used a formidable dynamic loudspeaker, with the lowest resistance voice coil I have ever heard of. The receivers were being traded in and scrapped during the brief period that I worked in the E.F. Wilks radio factory in the mid '30s.

Instead of a voice coil, as such, the speaker used a single strip of copper (or alloy) so punched and formed that it provided a 7/8th-turn in the magnetic field and two flexible legs which fed and supported the moving "coil". The sensitivity was very low but this was compensated for by an amplifier boasting a pair of type 50 output triodes, similar to those then being used for theatre sound systems.

But, contrary to what A.J. suggests, this set-up would not necessarily have made for improved electrical damping:

(a) Because of the low efficiency of the magnetic circuit, and

(b) Because, the impedance of the 7/8th-turn copper strip would have been so low that, in terms of damping, it would have posed a near impossible challenge for the output stage, transformer and connecting leads.

In short, loudspeaker damping depends on the relationship between the source and the output load, rather than on absolute values, A.J. then goes on:

The irony is that the same salesmen who will advocate heavy cables will also push expensive dynamic headphones for the "ultimate in fidelity", and the same "golden ears" will happily listen to them while they are plugged into an amplifier with a source resistance of some hundreds of ohms (viz. the usual series headphone jack attenuator, as in the EA 60/60 Playmaster) where the damping factor is virtually zero.

My own approach to the provision of adequate damping has been simply to shunt a 4Ω resistor across each head phone. As a bonus, the extra loss re duces to near-inaudibility the level of output stage hum, otherwise frequently evident at the headphone jack. Such a shunt should really be built into all am plifiers.

To someone who is ostensibly being supportive, I may appear to be some what hard to get on with by my rejoinder to the above can be no more enthusiastic than "Yes, but . . . " First off, the impedance and sensitivity of hifi headphones can vary widely with make and model. An 8Ω rating may indicate either the nominal internal impedance, or signify that they are suitable for use with an 8Ω circuit, even though their actual impedance is much higher.

Furthermore, because headphones are frequently bought as an afterthought and plugged into an existing system, amplifier designers have to be cautious about how they feed the headphone jack. If they wire it directly to the output circuit of a power amplifier, and the user unthinkingly plugs in a pair of actual 8Ω phones, he may zap his phones or his ears or both!

Even if the user avoids that situation by discreet use of the volume control, connecting actual 8Ω phones directly across the output circuit may expose residual hum and noise not audible in the loudspeakers — a point mentioned by A.J.

The simplest and most obvious answer is to insert resistors in series with the respective left and right phone feeds so that, if actual 8Ω phones are plugged in, the level will be limited to something subjectively comparable to that from the loudspeakers. With higher impedance phones,the voltage divider effect will be proportionately less and the level hopefully still adequate. (In the case of the Playmaster 60/60, the series components comprised a 330Ω resistor and a 22μF capacitor).

But what about the damping factor? Frankly, I'm not too sure!

With rare exceptions, loudspeakers are expressly designed for use with a low impedance driving source and their performance is measured and rated on that basis. If used with a high impedance drive amplifier, approximating constant current rather than constant voltage feed, the bass may be underdamped, particularly in non-sealed enclosures, and the mid/upper frequency response may begin to look like the impedance curve.

But headphone diaphragms operate in a much more confined environment, at a much lower amplitude and power level (a few milliwatts) and directly into the ear canal. Some are cushioned on both sides by entrapped air, some by layers of foam, while others are said to be "open", whatever the implications may be.

I simply cannot recall ever having seen more than passing reference in articles and textbooks to the effect of drive impedance on headphone damping and frequency response.

In his "The audio Handbook" (Newnes-Butterworth, 1975) Gordon J. King shows both a series and a series-parallel feed, similar to that suggested by A.J. and observes:

"Better attenuation is provided by the network shown . . . with the resistor values arranged so that (each headphone) is loaded across a low value resistance for the best damping, though the relative importance of damping for headphones is somewhat debatable".

On the other hand, he admits in the very next sentence that, while many manufacturers are content with a series feed, some go to the trouble of including the headphone feed in the feedback circuit — which is really doing it the hard way.

The problem is that both arrangements — shunting and feedback — tend to render the headphone feed less versatile, meaning that it really needs to be optimised for headphones in a particular impedance range.

On reflection, A.J., you probably cast a line with a new, nicely baited hook!

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If you have *any* doubt about how good Dolby Surround® Sound is with home TV, read these brief comments by independent authorities.

STEREOPHILE

About the Shure HTS 5000

"It is rare in audio to find a clearcut "best" of anything, but in surround decoders, the Shure is the hands-down winner. Simply put, the reason is its superb sound. It has focus, detail, definition and aliveness that I'd not previously heard from any surround decoders or synthesizers. . ."

"The overall effect is spectacular and authoritative—precisely what one wants from theatrical sound."

Bill Sommerwerck

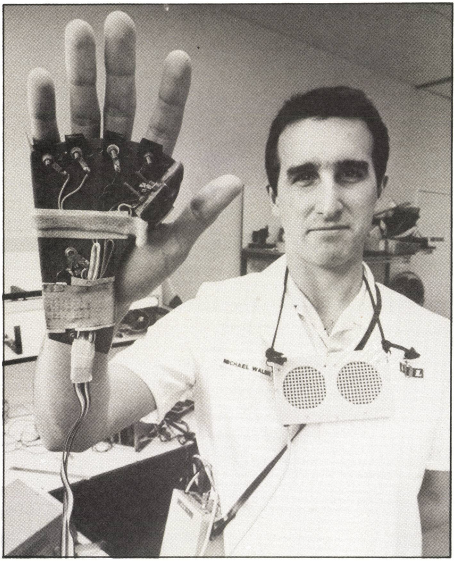
SHURE HTS 5000 HOME THEATRE SYSTEM

AUDIO ENGINEERS PTY. LTD
342 Kent Steet, Sydney, NSW 2000
Ph: (02) 29-6731

MARKETEC PTY. LTD.
51 Scarborough Beach Rd,
North Perth, WA 6000
Ph: (09) 242-1119

AUDIO ENGINEERS (VIC)
Ph: (03) 850-4329

News Highlights



Young achiever develops "talking hand"

The 24-year old Australian inventor of a unique aid for the vocally handicapped has won the inaugural Jeans West Science and Technology Young Achiever of the Year Award.

Michael Walsh, a 1984 Queensland University medallist developed a hand held talking aid while at university. His "talking hand" is soon to be placed in production by his first employer — Laser Dynamics, on Queensland's Gold Coast.

Michael's Young Achiever award was announced at a televised banquet in Brisbane. Five other under-25's received awards for achievement in sport, the arts, community service, careers, and entrepreneurial endeavour.

Michael is one of 29 new staff employed this year by LDL, recently listed on the stock exchange. He is a member of a four-person product development team.

The talking hand works by the conversion of finger pressure on a palm-held pad into normal sounding words. The coded pressure impulses are converted into audio tones by a compact speech processor. The words are broadcast via a small speaker which can be hand held.

Electronics courses at RMIT

Accredited electronic tradesmen and women eager to upgrade their skills in specialised technologies such as VCR, domestic video and digital audio should consider one of the courses offered by the Electronics Trade Department at RMIT (Royal Melbourne Institute of Technology).

Classes in these areas are usually offered in the evenings, but in special cases block release during the day or even off campus courses may be offered by the department for people living in country areas.

Electronics buffs may also wish to take advantage of basic training in electronics which is offered to the general public by evening classes which lead to a Basic Electronics Certificate. Some of the students attempting this course are already employed in the industry, but usually all that is needed is a general interest in electronics.

Further study through bridging subjects can lead on to elective subjects covering most areas of electronics. Students attend classes two evenings a week.

The Electronic Trade Department is part of RMIT's recent restructuring of existing Schools which has led to the formation of a School of Electrotechnology. Each department within this school is autonomous and is able to respond rapidly to the training needs of the industries serviced by each department's areas of expertise.

The Electronics Trade Department's prime teaching objective is to carry out the training of Industrial Training Commission of Victoria accredited Radio (Electronics) tradespeople. The apprenticeship course consists of 960 hours of training during the day for a minimum period of three years. For the final year, the student apprentice has the choice of one of four elective streams namely audio, colour TV, communications or digital.

In addition to the courses already mentioned, a service is provided for secondary students of schools from the metropolitan area on a daily basis in vocational Directional and Experience programs in basic computer and basic electronics for year 10 students and a Tertiary Orientation Course introduction for Year 11 students.

For further information on any these courses, contact Mr Nolan, Acting Head of Department on (03) 663 561 extension 425 or 426.

Large sale of Australian ear microphones to the USA

Heyden-Spike has sold 2,000 of its ar microphones which were developed, nanufactured and designed in Australia o the US Air Force in a deal worth 500,000. It has also bought its US distributor.

The managing director of Heyden-Spike, Mr Bob Spike, said the deal ould lead to the sale of "an incredible mount" of the in-the-ear units to the US military. "The purchase of our US distributor, Magnum Distribution, eemed a logical move because we wanted to expand our operations in the US. It is our biggest market," said Mr Spike. "Magnum has about 450 distributors in North America so we are transferring our international headquarters to the US".

The small ear microphone and receiver, which relies on air movement in the ear to create vibrations that are transmitted via a module attached to the user's hip to a radio receiver, is already used by NASA, the NSW and Australian Federal police, the FBI and the CIA.

The microphone was developed six years ago in the basement of a Sydney home by Mr Spike and his partner, Mr Paul van der Heyden. The pair realised there was a market for the device after working in the safety communications area in North America.

"Once we developed the microphone for use in the safety communications area for firefighters, police and the like," Mr Spike said, "we realised it had a dynamic application in other areas — especially military and surveillance."

The microphone has been used in Australia for the past few years. Mr Spike said Australia was used as a "testing ground".

"Our experience here helped us iron out the bugs and prepare us for sale and marketing overseas. The Australian Air Force had great success with the device as did Australian airlines and Ansett Airlines."

The microphone can be used in high noise areas where conventional head microphone and communication systems are usually inaudible.

Heyden-Spike currently employs 45 people in its Sydney plant and 14 people in the US.

Old radios coming back to life in Melbourne

An innovative Melbourne based com-any has begun reviving Australian alve radios from the 1920's onwards, many of which were featured in the arliest issues of this magazine when it as known as *Wireless Weekly*.

Resurrection Radio uses original com-onents, many new in boxes, to restore e sets to mint condition — examples f the first twentieth-century antiques, nd remarkably functional as well!

Australia played a major role in early dio and these sets embody an era of rosperity and imagination that manag-g director Stephen Moignard hopes ill come again.

The display and workshop is at 53 ang Street, South Yarra, where servicing and components sales are also available. A visit is likely to bring many memories for those who lived through the period and provides a constant source of amazement for younger people accustomed only to plastic and digital wizardry.

Enquiries may be directed to Stephen Moignard on (03) 820 1315.

Airline provides in-flight electronic games

On board all Singapore Airlines flights to and from Australia, you can now while-away the hours playing a series of "Brain Games". You can eliminate boredom by choosing from six games which you can rent for $US2.00 per hour. The "Brain Games" on offer are:

- Electronic chess
- Electronic backgammon
- Electronic poker
- Black jack and Gin Rummy
- Frogger
- Donkey Kong

Rental costs are charged directly to your American Express, Visa, Mastercard, or Diners Club account.

In addition to games being on offer in English, the airline also has French, German and Japanese versions available.

There is a minimum charge of one hour rental to get the games, and you are then charged for every additional 15 minutes. For those without credit card facilities, SIA cabin crew can provide hourly access.

All of the games are designed to fit on your tray table and come with step-by-step instructions.

Singapore Airlines marketing services manager for Australia, Paul Howard said "The new 'Brain Games' are available in First, Business and Economy Class cabins. They are designed to keep passengers entertained and occupied particularly on long flights."

"We promise not to tell, if the business executive prefers to play "Frogger" and wants to watch a frog leap between cars, across the highway while avoiding snakes and hopping onto turtles and logs to get home".

News Highlights

IBM scientists generate world's shortest pulses

IBM scientists at Yorktown Heights have made and measured the world's shortest pulses, an important step in designing the ultrafast electronic computer components of the future.

Using a laser and a very fast switch, the scientists produced electrical pulses lasting only one half of a picosecond (one trillionth of a second). Until this experiment, researchers had never broken the "picosecond barrier" with an electrical device.

Today's fastest experimental silicon logic devices can switch on and off in about 30 picoseconds; gallium arsenide devices in about 10 picoseconds. But to investigate the electrical behaviour of these devices, researchers must be able to measure pulses at least 10 times faster than these switching times.

The technique used to make the half-picosecond pulses can measure electrical pulses up to 20 times briefer than the switching times of the fastest present-day devices. As a result, IBM scientists will be better able to understand how electricity travels through computer components — transistors, chip connections and transmission lines.

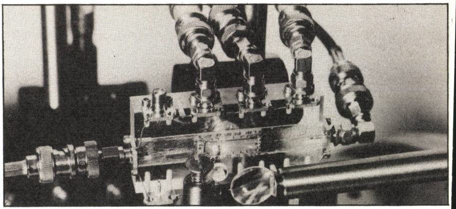
To generate the pulses, IBM researchers fabricated a transmission line on a thin silicon layer. The transmission line consists of two parallel one-micron-wide aluminium strips two microns apart. During operation, a voltage is maintained across the aluminium lines.

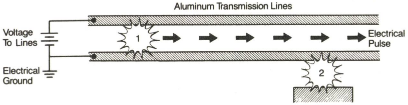
A pulsed laser beam, consisting of a series of sub-picosecond light pulses, is split into two beams by a mirror. Because the beams follow different paths it is possible to delay one light pulse stream.

The first light pulse strikes the silicon between the two aluminium lines, shorting them for a fraction of a picosecond and creating an electrical pulse that travels down the transmission line. The electrical pulse is an ultrashort change in the voltage that moves down the line.

As the electrical pulse travels down the line it passes a very fast optical switch which samples it.

The second light pulse, time-delayed slightly by the longer optical path drives the sampling switch, measuring the electrical pulse as it flies by. Researchers measure the time delay necessary to collect the electrical signal to determine the duration of the pulse.





Canberra FM station chooses Audiosound monitor speakers

Audiosound Laboratories recently supplied their latest 8045A Control monitors for the new 2CA studio in Canberra. They are to be used for the new FM station and the satellite service of Macquarie Broadcasting in Canberra.

The 8045A is a upgrade of Audiosounds' previous model the 8045, already used by 2CA, 2GB and the ABC. The 8045A features a new vented magnet woofer, high temperature voicecoil and restyled all-timber veneered cabinet.

Industry Briefs

- Australian industrial robot designer and manufacturer ***Machine Dynamics*** has been commissioned by the Ford Motor Company of Australia to supply two robo assembly systems. The contract is worth more than $5 million, and involves the design, manufacture and installation of 22 gantry robots with auxiliary gripping tooling and positioning devices.

- Dr Peter Crawford, former chief executive of the Sydney Water Board, has been appointed the new managing director of ***Amalgamated Wireless (Australasia)***. Former AWA chief scientist Dr Lou Davies has also been appointed to the board, to replace Mr E.B.Gosse, who has retired.

- Local printed circuit board maker ***Printronics*** has had its 18-layer PCBs tested independently by two overseas NATO contractors, who found them to meet both MIL-55110D and the even more stringent BS 9000 quality standards. Printronics recently installed the Multiline registration system for multilayer PCBs, which produces tolerances previously thought unachievable.

- Hobart-based antenna manufacturer ***Moonraker Australia*** has won contract worth about $500,000 to supply frequency agile HF antenna systems to ***Codan*** Australia's largest HF transceiver company. Moonraker has also won a contract worth more than $50,000 to supply marine radio antennas to the Australian Navy.

- Australian manufacturer ***STC*** has been awarded a three-year $A50 millio contract to supply PCM, digital multiplex and fibre optic telephone exchange equipment to the New Zealand Telecom Corporation. STC chairman Bi Page-Hanify says this is the largest contract for transmission equipment awarded to an Australian communications company for many years. For many years N has purchased this type of equipment from Japan.

- ***Crusader Electronic Components*** has been appointed Australian and New Zealand distributor for ITT Semiconductor's chips and SMD products. According to Crusader's managing director Des Connors this now gives his company complete range of active and passive components for local manufacturers.

Australian breakthrough in thermocouple technology

Yet another breakthrough in thermocouple technology has been made in Australia by leading researcher Dr. Noel Burley, General Manager R & D of Bell-IRH Limited. At this month's International Temperature Symposium in Sheffield, UK, Dr Burley will unveil a new high-performance sheath alloy for mineral-insulated thermocouples, known as Nicrobell*. This new alloy offers protective qualities even better than those of previously used sheath material such as stainless steel and inconel, coupled with thermal properties which match almost exactly those of the newer type N thermoelectric materials.

The development of Nicrobell is effectively a follow-on from Dr Burley's development of the Nicrosil/Nisil thermocouple, now promulgated internationally as the type N system (BS 4937:-Part8, ASTM E 230), and the "N-CLAD-N" mineral-insulated metal-sheathed (MIMS) type N thermocouple. These achievements largely supersede most existing types of base-metal thermocouple construction, and the new sheathing alloy seems set to complete this Australian-led revolution.

Nicrobell is a nickel alloy containing essentially chromium, silicon and niobium. It provides high-temperature mechanical properties superior to those of stainless steel and Inconel, while having thermal expansion properties which are almost identical to those of Nicrosil and Nisil. At the same time, it also offers freedom from the thermal diffusion and impurity migration effects which produce thermal instability by extraneous contamination in MIMS thermocouples sheathed in conventional materials.

In short, this new MIMS alloy appears to be very close to the optimum sheathing material for MIMS thermocouples operating at up to about 1250°C. The combination of one of Dr Burley's type N thermocouples, housed in a MIMS type probe with a Nicrobell sheath, seems set to become the preferred thermocouple sensor for a majority of applications in science and industry. This is because such sensors will show hitherto unattainable degrees of thermoelectric and environmental stability.

Currently various standards laboratories around the world are preparing to investigate Nicrobell-sheathed type N MIMS thermocouples to determine the degree of thermoelectric stability attainable. Several overseas MIMS thermocouple manufacturers are also making prototypes of this kind of thermocouple, as a precursor to full-scale commercial production.

Australian scientist Dr Noel Burley, a world authority on thermocouples.

Plans are also well under way for the production of this new type of thermocouple by Bell-IRH Limited.

* The composition of Nicrobell (a Bell-IRH tradename) is the subject of patent applications lodged by Bell-IRH Limited in Australia and a number of overseas countries.)

- Mr Lonnie Rush has been appointed managing director of ***AT&T International (Australia)*** succeeding Joseph Berrier who opened AT&T's Sydney office in 1981.
- Queensland laser manufacturer ***Laser Dynamics*** is expanding its Gold Coast factory and head office to more than double the existing production capacity. The expansion will add more than 1600 square metres, and is costing $500,000. It includes a secure area for work on defence contracts.
- A joint venture company has been set up by ***Amcor*** and ***BWD Industries*** subsidiary BWD Precision Instruments, to manufacture a new range of electronic instruments. To be called AB Systems, the new company will be making industrial instrumentation. Its first product will be an instrument for measuring the pulp concentration in paper making, known as the Polameter.
- The ***Australian Electronics Industry Association*** has elected Mr Brian McKay as its president for the next two years, succeeding Mr Bill Page-Hanify of STC. Dr Laurie MacKechnie of Plessey has been elected as vice president for the same period.
- The fourth ***Mathematics-in-Industry Study Group*** will be held at the University of NSW from February 1-5, 1988. Sponsored by the University and the CSIRO division of Mathematics and Statistics, the group seeks to further the transfer of mathematics ideas and processes to Australian industry. Further details are available from Dr N.G.Barton of the CSIRO, on (02) 467 6702.
- Datamatic subsidiary ***Data Peripherals*** has been appointed Australia and New Zealand distributor for the LAN products of US manufacturer AST Research. ***magineering*** will continue to be the distributor for other AST products in both countries.
- Sydney-based ***Innovative Technology*** has changed its business address to 5 Moseley Street, Carlingford 2118 (PO Box 458). The telephone number is (02) 872 500.

Radio operators prosecuted in two states

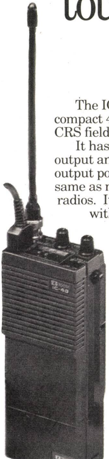
An amateur radio operator in Sydney has become the first in Australia to have his licence withdrawn under the Radiocommunications Act 1983. A citizens band (CB) radio operator in Brisbane has also been fined $350 and had his equipment confiscated, after being convicted of charges of harassment and being unlicensed.

A spokesperson for the Federal Department of Communications said that these prosecutions were the latest results of an ongoing campaign to clean up the airwaves across Australia. The spokesperson said CB radio operators and amateur radio operators faced an increasing risk of being prosecuted for the use of obscene language and other anti-social behaviour on air.

"We have to protect the airwaves against this type of abuse in the interests of operators who are properly licensed and show respect for others," the spokesperson said.

Under the Radiocommunications Act, it is an offence to use a radiocommunications transmitter for the purpose of harassing another person. Departmental inspectors conduct their own investigations and act quickly on complaints. Penalties for unlicensed operation can attract a fine of up to $10,000 and in addition a court may order forfeiture of offending equipment.

Now you don't have to be bolted to your vehicle to keep in touch.



The ICOM IC-40 is a compact 40 channel UHF CRS field proven hand held.

It has standard 2 watts output and optional 3 watts output power which is the same as many mobile radios. It is also available with optional 5-tone selective calling.

And is perfect for jobs on the land, water or business where you want to keep in touch with base without keeping in touch with your vehicle.

For all details see your ICOM dealer or call ICOM on Melbourne (03) 529 7582 or (008) 33 8915 from elsewhere in Australia.

ICOM

Henderson Merrick DiStefano / IC 465

News Highlights

Multi-colour moving display is portable

Moving messages are a sign of the times and the latest innovation in this field is the multi-colour, high-intensity "Colour Cells" electronic display board just released by Display Systems of Sydney.

Based on optical principles similar to those of colour television, the Colour Cells unit offers 16 different colours and is a significant advance on the original red or other single colour models.

Each unit is able to carry up to nine separate messages in any sequence. The units also produce graphics and symbols, suitable for illustrating all types of sales messages. Visuals include ships, planes, houses, cars, phones (with an accompanying ring), a beating heart, and a turning wheel.

"Our new portable signs offer smaller businesses and institutions such as video dealers a valuable addition to their marketing armoury" says Keith Rowe, general manager of Display System Australia (DSA).

"To operate the unit, the user simply holds a small infra-red programmer, keying his personal security password and appropriate message into the unit's 4096-character memory."

Text can be up to 70mm high and varies to produce three-dimensional, flashing, bold or italic characters, in upper or lower case.

Economical to run, the Colour Cells unit consumes between 30 and 50 watts of power and each light emitting diode (LED) is claimed to have a 15-year working life.

The Colour Cells display board retails for $1,795 and comes with a six months' full parts and labour warranty. It will be available from sign companies, display companies and shopfitters. Enquiries may be directed to DSA's Sydney headquarters, 127 McEvoy Street, Alexandria 2015 or telephone (02) 690 1988.

French Telecom orders 900,000 "Minitel" terminals

The French Public Telecommunications authority has ordered 900,000 "Minitel" videotex terminals from La Radiotechnique Industrielle et Commerciale (RTIC), an affiliate of the French Philips organisation. The terminals are to be delivered in 1987 and 1988.

The RTIC's Telematique Individuelle et Domestique (TID) division has been a pioneer in data communication and has already produced 600,000 terminals since 1983.

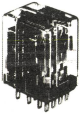
By November 1985, 1 million "Minitel" terminals had been installed in French households. One year later, the installation of 2 million had been surpassed and the latest indicators clearly show that growth is continuing at a rapid rate. In 1986 "Minitel" users generated a monthly traffic of 23 million calls to more than 4000 databases, a total turnover of close to one billion francs. This rapid adoption has been a genuine social phenomenon.

The ambitious plan for developing data communications in France launched in series by the French PTT at the beginning of the 1980's has been met. The target of 10 million "Minitel" terminals to be installed within less than ten years now looks likely to become reality.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

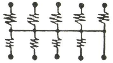
Genuine Fujitsu Relay for only $3.50



Geoff has managed to obtain a quantity of genuine Fujitsu 4 pole changeover relays type FRL263. They have solder/plug-in terminals and offer four changeover contacts rated at 3A. The coil is 24V nominal (650ohm). Fully enclosed.
Measures 22 x 28 x 40mm approx.

Fujitsu FRL263........only $3.50

10 pin SIL Resistor Networks



By popular request Geoff is now stocking resistor networks. They consist of nine resistors sharing a common connection in a ten pin in-line package. Available in the following values :
220, 330, 470, 680, 1k0, 2k2, 3k3, 4k7, 10k, 22k, 33k, 47k, 100k and 200k.
1/8W rating. Fits 0.1" grid.

Specify value... all 60cents

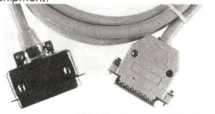
68000 Processor Chips on Special

Thomson brand 10MHz CPU chips. Yes the 68000 microprocessor for under $25!

TS68000CP10..............$24.00

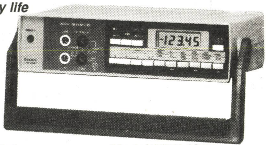
IBM Printer Cables

Approx 1.5m long with quality connectors on each end. You couldn't make one yourself for the price. We only hope our stocks last till this advertisment appears because you'll be paying more than $15 for the next shipment!



IBM Cable...........$15.00

** 4000hour battery life*
** LCD display*
** Audible continuity*



Model EDM-2347

Escort Battery/Mains operated Bench Type Multimeters

EDM2116 3 1/2 digit with capacitance

Ranges		Accuracy
Vdc	200mV to 100V	0.5%
Vac	200mV to 100V	1%
Adc	200uA to 20A	1%
Aac	200uA to 20A	1.5%
Ohms	200 to 20M	0.75%
Caps	2nF to 20uF	2%

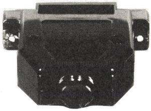
EDM2166.............$216 ex tax
$254 inc tax

EDM2347 4 1/2 digit with true rms,dB, frequency

Ranges		Accuracy
Vdc	200mV to 100V	0.03%
Vac	200mV to 100	0.5%
Adc	200uA to 20A	0.3%
Aac	200uA to 20A	1%
Ohms	200 to 20M	0.1%
Freq	20kHz to 200kHz	0.5%

EDM2347..........$406.35 ex tax
$471.36 inc tax

SPECIAL PRICES ON 'D' & CENTRONICS CONNECTORS

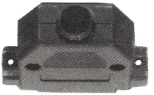


'D' Connectors

	1-9	10 UP	100 UP
DE9P	$1.68	$1.51	84¢
DE9S	1.80	1.44	90¢
DA15P	2.34	2.11	1.17
DA15S	2.42	2.18	1.21
DB25P	2.20	1.98	1.10
DB25S	2.72	2.45	1.36

Covers Metallised

9 pin	1.80	1.62	1.25
15 pin	1.80	1.62	1.25
25 pin	1.80	1.62	1.25



Covers Plastic

9 pin	1.60	1.44	90¢
15 pin	1.60	1.44	90¢
25 pin	1.65	1.48	95¢

Centronics Solder

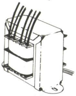
24 way male	9.60	8.64	4.80
24 way fem	10.00	9.00	5.00
36 way male	6.60	5.94	3.30
36 way fem	9.50	8.55	5.28

Centronics I.D.C.

36 way male	8.00	7.20	5.20
36 way fem	8.40	7.56	5.40

Microprocessor Transformer - ideal for projects

The JT348 is a locally made transformer specifically designed for you microproessor enthusiasts. It features three secondary windings giving you -



12V at 1A
12V at 1A
9V at 2.5A

Measures 115 x 70 x 65mm

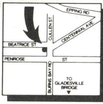
JT348..................only $18.50

8.30 to 5 Monday to Friday, 8.30 to 12 Sat.
Mail Orders add $5.00 to cover postal charges.

All prices INCLUDE sales tax.

Tax exemption certificates accepted if line value exceeds $10.00.

BANKCARD, MASTERCARD, VISA, CHEQUES



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News Highlights

Telecom ISDN contract to Ericsson

Telecom Australia has awarded a $26 million ISDN contract to Ericsson to provide equipment for the world's first national Integrated Services Digital Network (ISDN). The contract is for the provision of ISDN switching equipment.

The Telecom network will comply fully with international ISD standards and this will enable Australia to be connected to an eventual world-wide ISDN network.

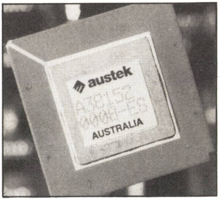
ISDN is the next significant development in telecommunications throughout the world, and its introduction to Australia will open up a new range of facilities and easier access for all types of communications. Voice, text, data and image will all be capable of being transmitted simultaneously over 30 channels of the ISDN access 2Mbs digital line. Each channel will be able to handle both voice and data at speeds of 64,000 bits per second.

The AXE telephone system which Ericsson supplies to Telecom for Australia's telephone network is now being geared for ISDN.

Ericsson's corporate relations director, Brian McKay says that any company using a digital PABX with an ISDN capability will be able to use the new network.

"As a result, one of the major areas of impact of ISDN will be on the PABX market and this is a logical place to start implementing ISDN because of the many benefits that will result to business and the community," he said. "It will give PABX and communications equipment precedence in the marketplace. Computers, telephone facsimiles, photocopies and laser printers will all be connected through the PABX for ISDN applications."

Telecom plans to launch the ISDN network commercially during 1988, following trials by selected major customers. The initial network, which is expected to expand rapidly, will consist of eight interconnected AXE digital central processor switches located in all major capital cities. There will be initially two in both Sydney and Melbourne, and one in Canberra, followed quickly by one each in Brisbane, Adelaide and Perth.



Australian-designed cache controller chip for 80386 micros

Adelaide-based VLSI design and manufacturing firm Austek Microsystems has announced the A38152 microcache controller, designed to dramatically boost the processing speed of Intel's 80386 microprocessor.

According to the company's general manager Denis Redfern, the A38152 is a world first, putting Austek Microsystems at the forefront of this type of microprocessor technology.

The Microcache is suitable for use in high-end personal computers and accelerator cards employing Intel's latest 80386 microprocessor. It is also suitable for use in other 80386-based systems, such as engineering workstations, network servers and standard bus processor cards (eg. Multibus and VME).

The A38152 is Austek Microsystem's first major commercial release of a mainstream microprocessor peripheral chip. Until now, the company has concentrated on producing very large scale integrated circuits (VLSI) in small batches for specific clients.

Major features of the A38152 include total control of a 32K byte capacity cache control memory, operation at speeds of 16 and 20MHz (with a 25MHz version planned), a direct interface to the 80386 microprocessor, a direct interface to Austek's 8K x 8-bit static RAM chips, full 32-bit addressability for 4 giga byte memory support, and cache coherency support.

Austek has samples of the 16MHz A38152 available now, packaged in 84-pin ceramic chip carriers, for $US198.00 (1-10 units). Production units will be available in September for $US58.00 (10,000 units). Plastic packaging is planned to be introduced in 1988.

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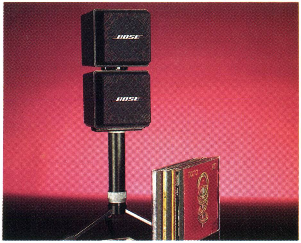

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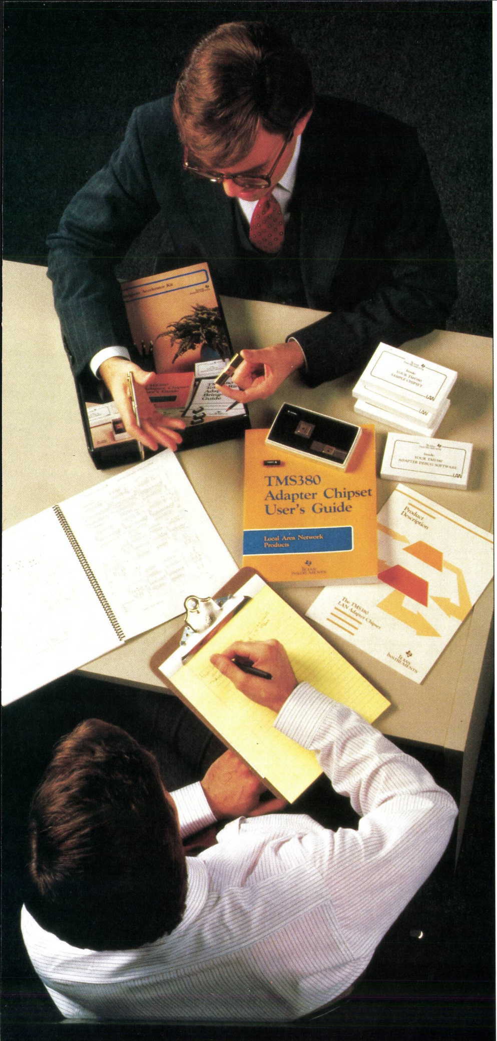
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User's Guide
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Q. What kinds of products can communicate through the new LAN?
A. With the TMS380 chip set, almost any.

TI's new TMS380 chip set was developed jointly with IBM. Its general-purpose system interface allows many kinds of equipment from various manufacturers to communicate through the IBM Token-Ring Network. And since this is an open network, any product in which you use the TMS380 can communicate with any other, when common languages are used.

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A. It's the heart of your LAN adapter card or subsystem.

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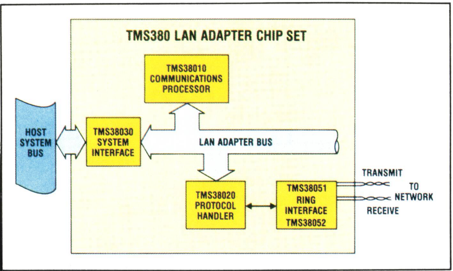
IBM compatibility with token-ring-LAN chip set.


TMS380 LAN ADAPTER CHIP SET
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Q. Can it grow with my needs and my customers'?

A. Yes.

On-chip RAS and LAN-management software make TI's TMS380 chip set completely compatible with the IBM Token-Ring LAN and give it a stable foundation to meet the need for future network expansion. As higher performance standards develop, the TMS380 chip set will accommodate them.

Q. What's this about an Accelerator Kit?

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The Serviceman

Another journey into the (largely) unknown . . .

In a sense this month's story is a sequel to the one I related last month, in that both represent jobs of the kind which take you out of the familiar round of TV receivers and video recorders. But this one concerns a personal computer, and a fairly ageing one at that, by modern standards.

As it happens, the computer didn't belong to a customer at all — it belongs to me. It's a System 80, a clone of the Tandy TRS-80 which was imported by Dick Smith Electronics between about 1980 and 1984. They were made in Hong Kong, I believe, and to the best of my knowledge quite a few tens of thousands were sold.

This one is one of the "Mark II" models, with a numeric keypad at the right of the main keyboard instead of the cassette tape deck built into the original models. The Mark II model could be provided with a matching expansion box and floppy disk drives, and was promoted for more serious "business" use. It used a Z-80 eight-bit microprocessor, and had a maximum of 48K of RAM — miniscule by modern standards, but it seemed impressive then.

I bought one about five years ago, complete with the 48K of memory and two floppy disk drives. The initial idea was to use it at home as a word processor, to write this column, and this worked out quite well. But a little later I bought a couple of additional software packages, one to keep track of spare parts and the other to take some of the hassle out of customer invoicing. Before long, it was spending most of its time at the shop.

The way these things go, after about two years it was getting harder and harder to use the System 80 at home for word processing. At the same time, it was getting close to obsolete — such is the speed that computer technology roars on. Obviously some other solution was becoming necessary.

This was about the time that IBM had released its 16-bit PC in Australia, so after a bit of consultation with Mrs Serviceman and our friendly accountant, I bought one of these. Naturally as my newest toy, it was taken home to become the word processor (!). It's still being used for this purpose, as it happens, and I'm writing this column on it.

The System 80 was left at the shop, because this would cause the least disruption to daily business. The stock control and accounting software packages available for the IBM all seemed to me horrendously expensive (nothing much has changed!), and they also seemed to be incompatible with those I'd been using on the System 80. After having gone through the exercise of setting up a spare parts inventory database and the invoicing package only a couple of years before, I didn't fancy going through the whole shebang all over again.

So it was easier to leave everything running happily on the System 80 at the shop, and take the shiny new IBM home. I still had to go through the business of changing over from the System 80's word processing package to the Wordstar which came with the IBM, but that didn't turn out to be too bad.

. . . carrying on the dubious tradition of the plumber's pipes leaking, etc . . .

Everything went along quite happily until a couple of weeks ago, when we turned on the System 80 one Monday morning to be greeted by a screen ful of random "garbage". It made a forlor effort to boot up a disk, but the seemed to sit there in stony silence.

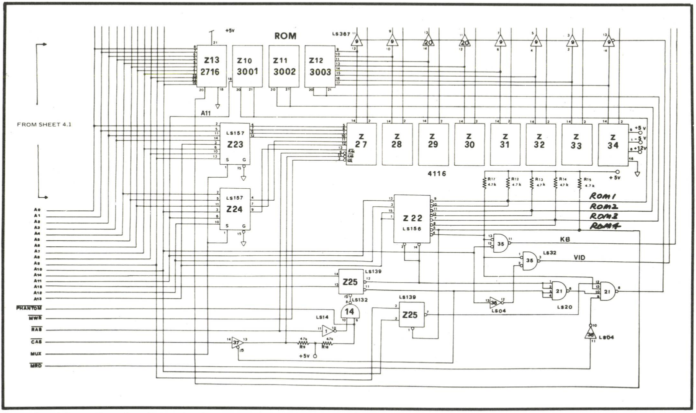
As luck would have it, I was absolutely snowed under with paying job from customers at the time (Murphy' Law, no doubt!). So all I could do wa turn it all off again and make a few ex asperated observations about carryin on the dubious tradition of plumbers pipes leaking and bootmakers' childre having to walk around in their socks.

It was actually the following Saturda afternoon before I could get a chance t tackle the System 80. In the meantime had managed to dig out the technica manuals I'd made a point of getting, a insurance against just such an eventual ity.

Now before proceeding with the ac tual servicing story itself (finally!), should note that where personal com puters are concerned, I'm far fro being an expert. In fact they're eve more in the category of "unfamilia territory" than the movie projector jo I described last month. I do have an un derstanding of the basic principles, bu when it comes to the fine details I' easily lost. From comments made b some of my colleagues, I'm sure I'm no alone here.

In fact I suspect that the only peopl who are really familiar with PCs an their peripherals are the technician who've made a speciality of servicin them exclusively. So my analogy las month of doctors is probably even mor appropriate here — the best person t solve this kind of problem is a special ist, not a "master of none" GP like my self.

Still, that's all very well in theory When it's your own jolly computer, an you are after all supposed to be a M Fixit, you just dive in and hope for th best. But the point I'm trying to mak



An extract from the circuit for the System 80 computer, showing the RAMs, ROMs and address decoding. At one stage I thought the fault was in one of the ROM chips . . .

is that for a specialist, this problem could probably have been knocked over in an hour flat. The fact that it took me considerably longer is largely the result of my having neither the first-hand experience, nor the specialised test equipment or replacement parts to tackle it more efficiently.

Despite this, I believe the story is worth describing because there are probably a lot of people — both servicemen and reasonably technical PC owners — in the same position.

OK then, to the story itself. From the symptoms, it seemed to me that the problem was likely to be in the video RAM circuitry, used to store the messages to be displayed on the computer's monitor screen. I deduced this from the fact that the screen was staying full of the random "garbage" which is present when power is first turned on to the RAM chips.

Normally these random characters are "cleaned off" the screen as soon as the computer gets going, under the control of the monitor program in the ROMs. As part of the program's startup or "initialising" routines, it usually sprays a string of space or blank characters into all of the screen RAM addresses, to replace the rubbish and clear the screen.

Obviously this wasn't happening anymore. But from the way the computer was apparently trying to boot up a disk, it looked as if the Z-80 CPU was probably OK and trying to work, and the disk controller circuitry was probably OK as well. (For those even less familiar with personal computers than I, a basic block diagram of the System 80 is shown in Fig.1)

There was obviously nothing wrong with the actual video interface circuitry, because there were characters being displayed steadily on the screen. The fact that they were rubbish was no doubt because the video RAM contained rubbish; something was stopping the CPU from writing its spaces or blanks into the RAM to wipe it clean.

After I took off the top of the computer case, I discovered that the video RAM circuitry was directly underneath the keyboard — Murphy's Law again. It took a few minutes to remove the keyboard in turn, and then work out where the video RAM memory chips were. They turned out to be two 2114 chips, each of which stores 1K of 4-bit words.

Working on my theory that the CPU somehow wasn't writing in the spaces to clear the RAM, I decided to use the CRO to monitor the 2114 "write enable" pins (pin 10), used to flip them into the write mode, while pressing the computer's reset button. Normally, you'd expect to see a string of pulses on these pins shortly after the button was pressed, as the CPU wrote in first a string of spaces, to clear the screen, and then its sign-on message.

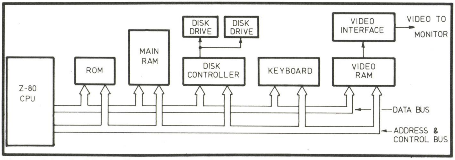


Fig.1: A basic block diagram of the System 80 computer. Many of the older personal computers are very similar. The ROMs contain the BASIC interpreter, plus an elementary operating system.

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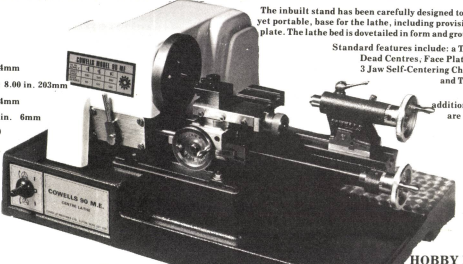

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Not surprisingly, there wasn't a sausage. So it was back to the technical manual, to see where the pulses should be coming from. Then back to the video circuitry with the CRO again, to try and trace them back to their normal origin — meanwhile pressing the reset button at suitable intervals, to hopefully create the right conditions.

At this stage I was working on the theory that the pulses were probably being generated by the CPU somewhere along the line. I supposed they were being stopped from reaching the video RAM chips by a faulty logic chip, or perhaps a PCB fault like a dry joint or broken conductor. But the further I went back along the chain towards the CPU, the more it became clear that this theory wouldn't hold up.

In fact it soon became obvious that the CPU wasn't making any effort to direct its attention to the video RAM. Not only was it not sending any write pulses to the video RAM chips, it was also not generating any of the video RAM's addresses. I could tell this by again using the CRO to monitor the "video RAM" output of the CPU's address decoder chip.

Now if I had one of those fancy logic analysers (and knew how to drive it!), this would no doubt have been a good time to hook it up to the CPU and see what was happening or not happening. Being an ordinary serviceman, I don't have such an instrument. But all was not lost — perhaps a bit of logical deduction could achieve almost as much, with the simpler tools available.

But then I remembered a technique that I'd read somewhere, of hard wiring the CPU's data pins . . .

I decided that a quick test, to check if the video RAM itself was capable of clearing the screen if given a chance, was to try "brute forcing" the 2114 chip write-enable pins to the active logic level, with a test lead. As it happens, these pins are of the active-low type, so it was simply a matter of shorting them briefly to circuit ground.

As soon as I did so, the existing screen garbage was replaced with a string of other characters. These were also pretty meaningless, but at least they showed that the video RAM was capable of being written into.

Perhaps the CPU was faulty? That seemed the next likely possibility, but I didn't have a replacement Z-80 to try substitution. And without a logic analyser there didn't seem to be any other way to check out this theory.

But then I remembered a technique that I'd read somewhere, of disconnecting the CPU's data bus pins from the rest of the data bus, and "hard wiring" them to give the same code as a no-operation (NOP) instruction. The idea behind this is that the CPU operates by fetching each of its instructions from the memory, and then carries them out. By wiring its data pins to give a permanent "twiddle your thumbs" NOP instruction, you force it to cycle through all of the memory addresses in turn, searching vainly for a more sensible instruction code.

The basic idea is shown in Fig.2. For a Z-80 microprocessor, the code for a NOP instruction happens to be 00 hexadecimal, or 00000000 binary, so this is achieved quite easily by tying all of the chip's data bus pins to ground.

One convenient way of doing this is to get a 40-pin DIL plug and socket, and make up a piggyback "NOP adapter". This has the socket mounted above the back of the plug, with all pins except the data lines connected directly from plug to socket. The data lines of the socket are not connected to the plug pins, but are tied together and connected to pin 29, the Z-80's ground pin. To use the adapter, the Z-80 is simply removed from its normal socket on the computer PCB, and then plugged into the adapter. The complete assembly is then plugged back into the PCB socket, and the power turned back on.

I gather that technicians who specialise in the repair of personal computers and other equipment using microprocessors generally have quite a few of these NOP adaptors made up, to suit the various processor chips.

In this case I didn't have a NOP adapter made up, because I haven't really needed to fix that many computers. I didn't even have a spare 40-pin plug or socket, for that matter, to make one up. However since it was my own computer, it wasn't too difficult to do the next best thing: cutting the PCB tracks concerned at the Z-80 socket, and wiring them temporarily to ground. It's butchery, but it works!

Somehow I didn't really think the Z-80 would turn out to be faulty, and it wasn't. When I turned the power back on and checked the Z-80's address lines with the CRO, everything was as you'd

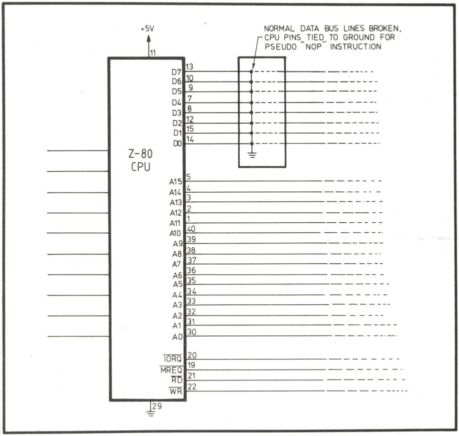
+5V
11
NORMAL DATA BUS LINES BROKEN, CPU PINS TIED TO GROUND FOR PSEUDO "NOP" INSTRUCTION
Z-80 CPU
D7 13
D6 10
D5 9
D4 7
D3 8
D2 12
D1 15
D0 14
A15 5
A14 4
A13 3
A12 2
A11 1
A10 40
A9 39
A8 38
A7 37
A6 36
A5 35
A4 34
A3 33
A2 32
A1 31
A0 30
$\overline{\text{IORQ}}$ 20
$\overline{\text{MREQ}}$ 19
$\overline{\text{RD}}$ 21
$\overline{\text{WR}}$ 22
29

Fig.2: How to connect the Z-80 processor chip's data lines to ground, so it fetches a permanent "NOP" instruction. This forces it to cycle continuously through all of its addresses.

expect. Each one had a regular square-wave signal, with the frequency on each of the higher lines being half that of the one before. Obviously the Z-80 was cycling through all of its 65,536 addresses over and over again, trying valiantly to find an address that didn't contain a NOP instruction code. It was performing perfectly normally, at least in that respect.

So it was a matter of turning off the power again, removing the wire grounding all of the Z-80 data lines, and reconnecting them all back to the data bus. Then time for some more thinking.

If the video RAM was OK, and the CPU was also OK, that seemed to suggest that the CPU wasn't doing the right things because there was something wrong with the initialising routines in the monitor program. As this program was in the ROMs, along with the computer's built-in BASIC language interpreter, this suggested that the fault might lie in one of these ROMs.

Perhaps DSE would still have a technician who remembered the System 80 and could offer some help?

Hmmm . . . I didn't have replacement ROMs to do any substitution, either. What to do?

At this stage I decided to leave it until first thing on the following Monday, and ring up the service people at Dick Smith Electronics. Their company hadn't sold the System 80 for a couple of years, but perhaps they'd still have a technician who remembered the model and could offer some assistance. They might even be able to help with a loan of some replacement ROMs.

When I did ring on the Monday morning, they were indeed able to help. One of the technicians who had worked on the System 80 was still on the staff, and as a special favour I was able to have a quick word with him. After listening to the symptoms and the results of my sleuthing so far, he suggested that it could *possibly* be one of the ROMs as I thought, but in his opinion it was more likely to be one of the main RAM chips. Apparently the monitor program used the main RAM to store some of its working counters, and in the technician's experience the RAM chips were somewhat less reliable than the ROMs. In cases like this, he'd generally found the cause was a faulty RAM chip.

Just in case it might be the ROMs, he did have a set of them still tucked away in the DSE service department, and was happy to make them available on loan for me to try substitution. All I had to do was arrange for them to be picked up. In the meantime, he suggested, why not try substituting for the RAMs?

That sounded like a good idea, so as soon as I had arranged for Mrs Serviceman to call in later in the day to pick up the ROMs, I decided to give it a try. Only to discover that I didn't actually have any spare RAM chips — they were type 4116s (16k x 1 bit dynamic RAMs). Murphy's Law strikes yet again!

Then I had one of those all-too-rare strokes of inspiration. The computer's own expansion unit had two more rows of the very same RAM chips in it, and they were almost certainly OK! The logical thing to do was open up the expansion unit and use one of these to find the faulty chip in the computer itself.

I soon had the expansion box open, and discovered to my relief that its RAM chips were plugged into sockets, like those in the computer. Whew! This was going to be easier than I thought — no messy soldering and unsoldering.

So I set about substituting one of the expansion unit chips for each one of the computer's own chips, one by one, turning on the computer each time to check if the monitor screen would clear and give the normal sign-on message. (I had temporarily disconnected the expansion unit, because the fault was obviously in the computer itself.)

The first chip substitution produced no improvement, so that one was probably OK. I replaced the original chip, and tried substituting for the next one. Still nothing, so I proceeded to the next. Nothing again, so I tried the third — with the same result again. It didn't look too promising.

But then, with the fourth chip, there was a dramatic change. When I turned the computer on this time, most of the garbage cleared off the screen and a rough approximation of the normal sign-on message appeared. It was still a bit garbled though, and there were a few weird characters still sprinkled over the screen in places where they shouldn't have been.

Hmmm — the RAM chip I'd just substituted for was obviously faulty, but could there be a second gone faulty as well? It didn't seem too likely, but there was nothing to be lost by pulling out a second chip from the expansion unit, and using it to continue the substitution (with the first one in the fourth position, replacing the known faulty one).

Sure enough, it turned out that the sixth RAM chip was also faulty. Substituting for it suddenly brought everything back to normal, with a cleared screen and the normal sign-on message.

So I had found the source of the trouble, with a little help from the friendly DSE serviceman. The only thing was that by now, Mrs Serviceman was probably at DSE, picking up the set of ROMs which were now not required. Hopefully if I could get a message through in time, she would be able to pick up a couple of 4116 RAM chips instead.

I made quick call to DSE, only to find — yes, you guessed it — she had already been there and gone! Sometimes one's better half is a little too efficient . . .

Needless to say I had a certain amount of explaining to do when she dropped in at the shop, but she took it calmly and even volunteered to drop them back next morning and pick up the RAMs. So by lunchtime the next day, our trusty System 80 was back on the air again, looking after our spare parts and spitting out invoices.

All in all I didn't feel too badly about the time I'd taken to find the trouble, or the help I'd needed from the guy at DSE. After all, a normal "GP" serviceman like myself doesn't get much of a chance to get really familiar with personal computers. Nor do we do enough of this work to justify investment in the specialised test gear needed to troubleshoot them efficiently.

So considering my sketchy knowledge of these gadgets and the limited tools available, I don't think I did too badly. Hopefully my experience may give you encouragement to "have a go", if you find yourself in a similar position.

TETIA Fault of the Month

Hitachi CRP-141 (NPC6C-2 Chassis)

Symptom: Won't start up, or starts but runs poorly with low B+ rail

Cure: C919 ($3.3\mu F$ 25V electro) dropped in value. This capacitor forms a bypass on the supply to the chopper pre-drive transistor. Excess ripple at the emitter tends to cancel drive pulses at the collector.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, Tas. 7015.

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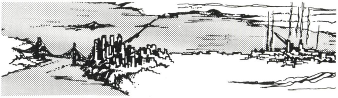
Silicon Valley NEWSLETTER . . .



The growth of Chips & Technologies

On a laboratory workbench at Chips and Technologies in Milpitas stands a 2-foot-high electronic mess: a jungle of wires, circuit boards and more than 200 computer chips.

This pile represents the supporting cast of semiconductors used to operate a complex microprocessor chip. But the odd assortment really isn't necessary any longer. Using advanced semiconductor technology and sophisticated computer design techniques, Chips and Technologies can electronically shrink this mess of circuitry into just eight chips, each about the size of an Australian five cent piece.

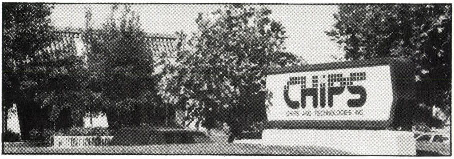
The process is an example of what's known as "integration", and 2-year-old Chips and Technologies has used this technique to great advantage. In doing so, it has become one of the chip industry's most energetic and best performers.

At a time when big chip makers are still struggling with a prolonged recession, Chips and Technologies has turned in an inspired performance. Sales and earnings have soared, the company successfully made its initial public offering of stock, and one Wall Street analyst has touted the firm as "blazing a trail for a new breed of semiconductor companies".

Like Chips and Technologies, more and more firms will be trying to hitch their wagon to integration in years to come. The process might seem trivial to outsiders. After all, as long as a computer gets the job done, what does it matter how many chips or circuit boards make up the innards? But to system houses it matters a great deal, and that's the point Chips and Technologies has seized upon so successfully.

In its fiscal year ended last June, sales totalled $12.7 million; this year, industry analysts estimate sales will grow more than fivefold, to about $70 million. The company, which has 100 employees, has posted a pre-tax return on sales of 36 percent.

So far, two products have accounted for Chips and Technologies' success. One is a set of logic chips used in so-called "clone" personal computers that are compatible with IBM's PC/AT model. The other is a set of graphics chips that enhance the performance of IBM and IBM-compatible personal computers.



Outside the Chips & Technologies plant in Milpitas.

C&T chairman and president Gordon Campbell, who founded the company two years ago.

The logic chips are a good example of the approach to integration that Chips and Technologies is pursuing. A five-chip set the company introduced recently allows computer makers to replace 67 of the 94 components found on the main circuit board of an IBM AT.

Chips and Technologies' strategy is to design and market its products but to avoid committing itself to a costly manufacturing plant. Instead, it relies on subcontractors — mostly in the Far East but including National Semiconductor of Santa Clara — to produce its chips.

"We've got to keep this company as lean as we can", says chairman and president Gordon Campbell. The 42-year-old executive departed San Jose semiconductor maker Seeq Technology in 1984, following a bitter dispute with the firm's board of directors.

Much of this new company's success lies in a custom-built computer-aided design and engineering system. It lets Chips and Technologies' engineers design high-density chips in a relatively short time and with a high probability that the designs will work the first time, Campbell says.

Analysts say Chips and Technologies jumped off to such a strong start that it has nearly a year's lead over a number of smaller firms, as well as big chip firms such as Intel of Santa Clara. Ironically, much of Chips and Technologies' product line supports Intel microprocessors, and Intel admits it missed the boat on supplying those parts itself. "Intel left a window open," Intel Chairman Gordon Moore said recently.

Millard finds buyer for his Computerland holdings

William Millard has found a buyer for his Computerland computer retail chain in which he controls 75% of the stock Millard has sold his holding to a group of New York-based investors, headed by E.M. Warburg Pincus & Co.

The financial terms of the deal were not announced, but one insider said he valued the transaction at around $US250 million. That would represent a far smaller amount than the estimated $US1 billion Millard had reportedly sought when he first announced his intention of selling his Computerland holdings last year.

Although he no longer owns any part of Computerland, Millard will apparently press ahead with his appeal to the 1985 Oakland jury ruling that awarded Micro/Vest 20% of Millard's Computerland holdings, plus some $140 million in punitive damages.

With its verdict, the jury upheld a clause of a $US250,000 loan agreement that Millard signed in 1976 when he formed Computerland. The clause stipulated that the holder of the note would be entitled to receive 20% of Millard's Computerland holdings in exchange for repayment of the loan.

Industry analysts said the take-over by Warburg will mean a boost for Computerland, as the investment firm has apparently promised to invest more capital into the 800-store computer retail chain.

The deal also formally separates all remaining ties Millard may have had with the company. Millard's stubborn opposition to changes in the Computerland organisation had caused a major rift between the corporation and a majority of the store owners.

Fujitsu and Fairchild strengthen ties

Despite the successful effort by the Reagan Administration to prevent Japanese firm Fujitsu from taking over Fairchild Semiconductor, the two firms continue to closely align their product, marketing and manufacturing operations.

Fujitsu may be the chief financial backer of a management buy-out deal being developed by Fairchild's management. The deal would reportedly give Fujitsu a 30% stake in the new independent Fairchild operation. Fairchild's management, on the other hand would control just 15% of the company, and Schlumberger, the current owner, would retain a 10% share. Another unidentified computer company would acquire a 30% stake, and the remaining 15% would be sold to investment bankers.

Fujitsu has begun producing semiconductors for Fairchild. Fujitsu said it has begun production on Fairchild's 32-bit Clipper microprocessor, as well as certain custom-designed chips. The chips produced at Fujitsu's Wakamatsu facilities, will be sold by Fairchild.

The agreement to produce some of Fairchild's products was made some time ago, but was kept secret for fear of adding even more fuel to the controversy over the proposed sale of Fairchild to Fujitsu.

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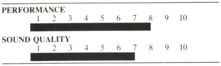
Compact Disc Reviews

by RON COOPER

EINE KLEINE NACHTMUSIK KV525

Divertimento No.10 KV247
Edward Melkus
Capella Academica, Wien
Denon 33C37-7808
Playing Time: 52 min 17 sec.



Probably Eine Kleine Nachtmusik (a little night music) is the most popular of all chamber music ever written. There are countless recorded versions, and because it is so well known there has become a "standard" way in which it is performed.

Written in 1787 after Mozart had moved to Vienna, it is not known exactly how it came to be written, but it was composed around the time of other masterpieces such as Don Giovanni.

The performance here is very different from any Eine Kleine you have heard before. At first it tends to sound a bit brash, but this is partly due to the somewhat over-reverberant sound and possibly the brightness of the original instruments used. However, with serious listening a sense of very careful playing emerges.

Curiously I found the tempo of the final Rondo Allegro disappointingly slow, yet according to the well prepared notes, Edward Melkus is an expert on interpretation. No doubt there are reasons for this.

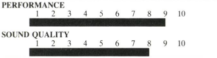
Compared to the Eine Kleine I found the Divertimento a trifle boring. It was written for Antonia, the Countess Lodron with whom Mozart was familiar, to celebrate her baptism.

Whilst I am not a fan of original instruments, mainly because I usually hear tuning limitations, this recording does not suffer in this respect. However, the overbright reverb coupled with these instruments, does create a "different" sound which takes a little getting used to. (R.L.C.)

33C37-7867
PCM DIGITAL
DENON
j. haydn: cello concerto in c major
j.c. bach: sinfonia concertante
w.a. mozart: 2 sonatas
Mari Fujiwara
Jean-Jacques Kantorow
Netherlands chamber orchestra

HAYDN CELLO CONCERTO

J.C. Bach: Sinfonia Concertante in A Major
W.A. Mozart: Sonata in C Major
Sonata in F Major
Decca 33C37-7867
Playing Time: 48 min 16 sec



This excellent disc contains a variety of interesting chamber works and should appeal particularly to those who already have most of the standard works in their collection.

The Haydn cello concerto featured here is not the usual D major concerto associated with this composer, but a relatively newly discovered work in C major. A part score of this work was uncovered in 1961 at the National Archives in Prague. Written in 1783, it retains remnants of the Baroque style and differs greatly from the D major work. I found it most enjoyable, and impeccably performed here by Mari Fujiwara with superb support from the Netherlands Chamber Orchestra.

The J.C. Bach work is typical of Bach's youngest son, always exciting music. The style of Sinfonia Concertante could be said to be their intermediate form between the baroque Concerto Grosso and the solo concerto. There is an almost continuous dialogue between the soloists and the orchestra throughout the work, and the solo cadenzas are beautifully enhanced by the silence of CD.

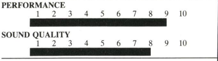
The last items show off this CD silence even more, with just a solo violin and cello in two most interesting little known Mozart sonatas.

The sound on this disc borders on exemplary. It is clean and bright with plenty of presence. The Haydn cello work is rather closely miked, as you do hear quite a bit of finger work, but I didn't find this too distracting.

Good programme notes are provided, even for the superb artists. A very worthwhile disc. (R.L.C.)

RACHMANINOFF PIANO SONATA No.2

Etudes-Tableaux
Preludes
Helene Grimaud
Denon 33CO-1054
Playing time: 43 min 56 sec.



Much of Sergei Rachmaninoff's (1873-1943) music was written for himself, as he was a very accomplished concert pianist. His style represents much

of the 19th century romantic, — Tchaikovsky and the like, which is understandable as most of these works were written around 1910-1915. His unique and powerful characteristics have left us with a rich musical legacy. He wrote two sonatas, the first was based on Goethe's Faust and is rarely performed.

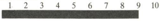
The second one, performed here is the most popular written originally in 1912, curiously in a rented room in Rome once occupied by Tchaikovsky. It was revised and reduced in length by him in 1931. This revised version appears on this disc.

Like other new piano recordings I have reviewed, this disc shows off the superlative piano sound of CD mainly due to the complete absence of noise between the notes — no distractions and zero wow imperfections — all music. The sound is very clean, full sounding with the reverberance of a large hall. Maybe it is a touch bass light, but this would depend on the acoustics of the recording and your preference. Overall a very fine recording. (R.L.C.)

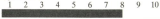
BRAHMS SYMPHONY No.3

Academic Festival Overture
Chicago Symphony Orchestra
Sir Georg Solti
Decca 414 488-2
Playing Time: 49 min 46 sec

PERFORMANCE



SOUND QUALITY



Seven years after Brahms had completed his 1st symphony, he was at the age of 50, a much respected and established composer. By this time he had behind him the great success of his 2nd symphony and piano concerto and had been honoured with doctorates from the University of Cambridge (which he declined) and Breslau. He was internationally famous.

It seems though that in 1883 he "knocked off work to carry bricks!" for he went to Wiesbaden for a rest and promptly composed this magnificent 3rd symphony. It was performed on December 2nd that year and like the previous one, was an immediate success. Hanslick wrote of it "Many may prefer the titanic force of the First, others the untroubled charm of the Second . . . but the Third strikes me as artistically the most perfect. It is more compactly made, more transparent in detail, more plastic in the main theme, the orchestration is richer in novel and charming combinations: in ingenious modulations it is equal to the best of Brahms' works."

In acknowledgement of the honorary doctorate conferred on him by Breslau in 1879, Brahms composed two works in 1881. One of these was the very musically rich Academic Festival Overture, a rollicking pot-pourri of student songs ending with the famous "Gaudeamus igitur." This is my favourite Brahms symphony, and this magnificent recording made around 1981 and an analogue version, is still the best I have heard to date. (R.L.C.)

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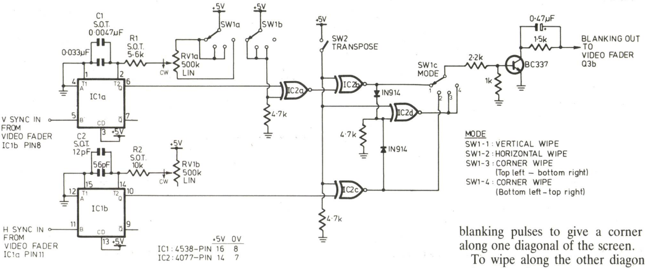
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.



Wipe effects for the video fader

This circuit is an add-on enhancement for the EA Video Fader of January 1986. It gives more variety to home video editing, by adding wipe effects to the fade effect originally provided.

IC1 is a dual monostable, triggered by horizontal and vertical sync pulses extracted from the Video Fader. RV1 sets the monostable's output pulse width, and hence the position on the screen of the blanked/unblanked transition.

This would give simple horizontal and vertical wipes if the Q and Q-bar outputs of IC1a and IC1b were only connected directly to the four position of SW1c. However IC2 allows further flexibility.

When SW2 is opened IC2b, IC2c and IC2d change from non-inverting to inverting gates. This transposes the position on the screen of the blanked and unblanked portions. In addition, IC2d combines the horizontal and vertical blanking pulses to give a corner wipe along one diagonal of the screen.

To wipe along the other diagonal requires that, for one monostable: the direction of its wipe is reversed, and its output is inverted. This function is provided by SW1a, SW1b and IC2a.

R1/C1 & R2/C2 are critical for best fit of the corner wipe, and they should be selected on test. First select C1/C2 with RV1 at maximum, then select R1/R2 with RV1 at minimum. R1 and R2 must not be less than 5.6k (IC manufacturer's spec). No other components are critical.

Peter Prause,
Kewdale, WA

$25

Centronics interface for Apple II+

This Centronics parallel printer interface is suitable for an Apple II+ computer. I have also enclosed a listing of a suitable driver program.

A significant advantage of this card is that it is simple. I could not get conventional cards to work on my computer, so I built this interface. I mounted it in a fibreglass box outside the computer to save wiring.

The interface should work with any standard Centronics interfaced printer. It allows software to send data to the printer and to initialise the printer. It also adds an extra 1K of memory to the computer in which to store an interface program. The additional memory is in four pages which may be selected by software on those pages.

For memory the interface uses two 2114 static RAMS (1K x 4 bits) which need no logic to connect straight to the Apple I/O. A 74LS244 tri-state octal buffer is used to monitor the outputs of the printer (PE,BUSY, ERROR, SLCT, ACKNLG-bar). Three of its inputs are not needed and may be connected to ground if no further expansion is desired. Logic is used to ensure that it is in high impedance state unless R/W-bar is high and Device Select is low.

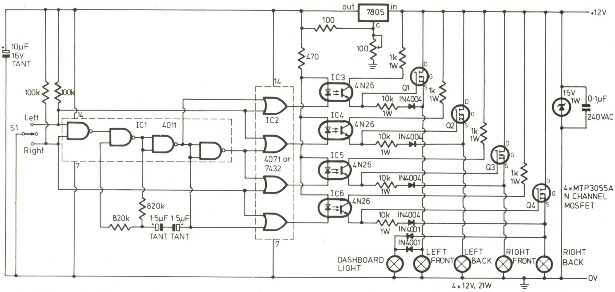
For output to the printer, two latches are used, the control latch (a 7475 quad latch) and the data latch (a 74LS373 octal latch). The control latch has two bits going to the high address lines of the RAMS to select memory pages, and two bits going to the STROBE and INIT printer inputs. Logic is used to ensure that these will only be accessed when R/W-bar is low, Device Select is low and the correct address line is high (AO for the control, A1 for the data).

A summary of interface locations is as follows. These values are for slot two only. If the card were used in other slots, the locations would differ.

C090 — load from here for printer status byte
C091 — store the control byte here
C092 — store the data byte here
C100 to C1FF — RAM interface memory (selectable)

Thus to print a character, the hex code of the character is fed into $C092, then $C091 is accessed twice, once to send STROBE low, then once to send it high again. To make sure that the printer is free for the next character, the program must wait until BUSY is low (it can check BUSY by loading from $C090).

The listing is of a very simple drive routine, but, with 1K of memory at th programmer's disposal, a much mor elaborate routine including a scree dump, Hi-Res graphic dump and specia BASIC list routine could be constructe (I have made these separately, but I se no need to include them in the routine)



Turn indicator flasher

I have called this design the "Urban Indicator" and its purpose is to switch automotive or motorcycle turn indicators. A novel function of the circuit (which I have used on a motorcycle for over a year) is that it switches the indicator lights out of phase, that is the rear one is on while the front one is off and vice-versa. The circuit shown will operate in this manner although it can be modified to operate as standard with the moving of two MOSFETs. It will also function as "hazard" lights with the addition of a suitable switch.

A 7805 IC is used as a current regulator for the CMOS chips, the supply line being noise filtered by the zener diode. Switch S1 is a centre off type with the centre connected to ground. When a turn is to be indicated S1 enables a NAND gate oscillator operating at 1Hz. It also enables "left" or "right" through a 4071 or gate, whose output goes low switching on an optocoupler device which can be part of a quad package.

The optocoupler applies a voltage that is quite close to line voltage to the gate of a power MOSFET, which switches on one of the globes.

The MOSFETs, made by Motorola and available from VSI should use the metal case as a heatsink and can handle high currents. The 7805 can use similar heatsinking but must be insulated. The MOSFETs don't need insulation if the metal case is isolated from the vehicle's body.

I hope others enjoy building and using this circuit as much as I have.

Karl Stevens,
Willoughby, NSW.

$15

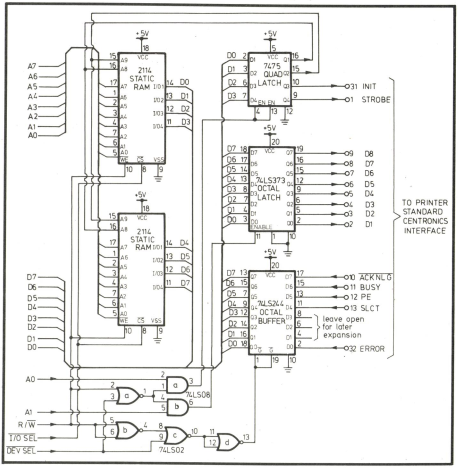
```
*C100.C13B

C100- A9 00 8D 91 C0 20 A8 FC
C108- A9 0C 8D 91 C0 20 89 FE
C110- 20 93 FE A9 1E 85 36 A9
C118- C1 85 37 4C EA 03 48 29
C120- 7F 8D 92 C0 A9 04 8D 91
C128- C0 A9 0C 8D 91 C0 20 35
C130- C1 68 4C F0 FD AD 90 C0
C138- 29 40 D0 F9
```

It is generally true to say, however, that the "dumber" the interface, the smarter the user needs to be. Especially with word processors, an intelligent interface only gets in the way.

The routine is not relocatable, so it must be changed if it is to be used in a slot other than number 1. Because of this, it is more memory and time efficient than those routines stored on ROMS. It is also infinitely more flexible as it can be changed from software.

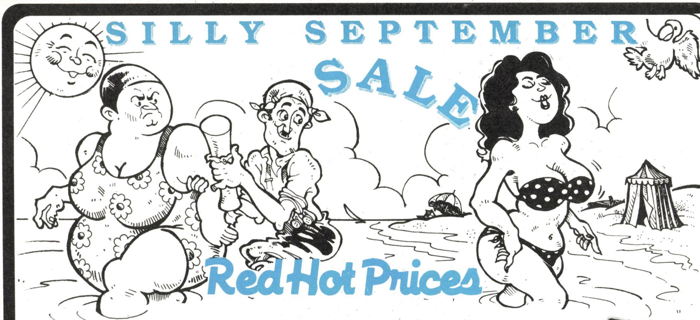
Ross Donelly,
Lindfield, NSW.

$20



JAYCAR JAYCAR

SILLY SEPTEMBER SALE



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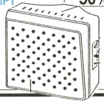

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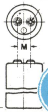
Terminal M5 screw

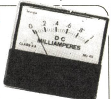
$7.50 ea



QUANTITY DISCOUNTS:

1 - 5	$7.50
6 - 10	$7.00
11 - 24	$6.50
25 - 99	$6.00
100+	$5.75

1/2 PRICE PANEL METER



Our overseas purchasing department ordered the wrong panel meter. It is an MU52 0-5 AMP. The MU52 is only slightly larger than the MU45 type. Size is 60mm wide by 55mm wide.
Cat. QP-5033 **NORMALLY $14.95**

NOW ONLY $7.50 ea

MASSIVE SCOOP PURCHASE

ROVER NEGATIVE ION GENERATOR

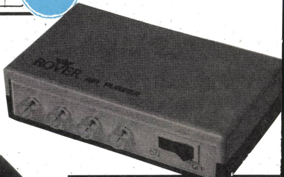
$29.95
SAVE $50.00
ALMOST 2/3 OFF!

NEW

NEGATIVE AIR IONISER

The Country Air negative ioniser was advertised extensively on radio last year for $200. Well, make a long story short "Country Air" is no longer around. (Except as air in the bush!) Hundreds of partially assembled ionisers were left with the contract manufacturer. They contacted Jaycar with their problems. Jaycar has underwritten completion of these ionisers but at a massive loss to the orginal party.
Their loss is your gain, however!! We can now offer this very high quality product at only a minute percentage of the manufacturers original selling price.
Cat. YX-2902

Yes, we've made another scoop purchase. The importer contacted us with his dilemma and we purchased a quantity of these fully imported fully guaranteed air purifiers. These units are 240 volt operated, draw about 1/2 watt, deliver about 250 billion ions per second, and cover about 25 square metres. It's even supplied with a Testor PC board and spare needles. If you've ever wondered about negative ion generators, this MUST be the time to buy one. These were selling for about $80. Jaycar has a limited quantity available.
Cat. YX-2905



ONLY $29.95

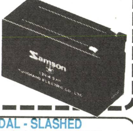
INCREDIBLE BARGAIN

BOTH THE SAME FANTASTIC PRICE

No.1 FOR SILLY PRICES ON NEGATIVE ION GENERATORS

JAYCAR JAYCAR

GEL RECHAREABLE BATTERIES - *SLASHED!*



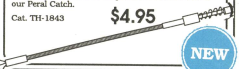
1.2 AMP
ONLY $22.50
SAVE $6.00
Cat.

4.5 AMP
ONLY $39.50
SAVE $10
Cat.

"THE CLAW"

This is a king size version of our Pearl Catch. Incredibly handy tool for when you need 4 hands. Push the finger grip down at the top and 4 claws emerge from the bottom to grasp and hold small nuts, bolts, washers or virtually anything. It measures 610mm long and is flexible. The best thing about the claw is its price, it's even less than our Peral Catch.

Cat. TH-1843 **$4.95**



NEW

TV GAME/COMPUTER SWITCH

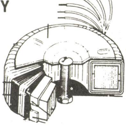
Allows you to easily switch between two inputs to your TV. The input can be TV aerial, computer, video game or VCR. The output has a small length of coax and a 75 ohm standard plug. Input sockets are standard 75 ohm type. Grab one for when you will need it.
ANOTHER DISTRESS STOCK PURCHASE.

NORMALLY
$5.95
Cat. LT-3018
NOW ONLY
$3.95

300VA TOROIDAL - SLASHED

We're heavily overstocked on our MT-2136 Toroid. It is a 300VA unit with two separate 30V 5 amp windings as secondaries.
They are normally $75 but this month you can grab one (or 2) for only $49.95 each - a massive saving of over 33.3%!!
Cat. MT-2136

NORMALLY
$75
SEPT SPECIAL
$49.95
SAVE OVER $25/unit



NEW NIBBLING TOOL

This easy to use tool has plastic covered handles and is suitable for steel up to 18 guage. It will, however, only cut in straight lines. Also suitable for plastics. Length 250mm.
Cat. TH-1768 Replacement blades Cat. TH-1769 - $3.50

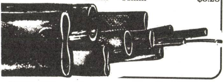
ONLY $19.95

MUCH EASIER TO USE THAN CONVENTIONAL NIBBLING TOOL

NEW HEATSINK TUBING

We now stock High Quality Japanese made heatshrink. It's industrial grade with a temperature rating of 90 degrees C, voltage 600V. To shrink you can use a match, heat gun, or even paint stripper. Black in colour it is supplied in 1 metre lengths.

Cat. No	Size	Shrink to	Price
WH-5530	1.5mm	0.8mm	$1.50
WH-5531	2.5mm	1.5mm	$1.50
WH-5532	3.5mm	2mm	$1.50
WH-5533	5mm	2.9mm	$1.70
WH-5535	10mm	6mm	$2.25
WH-5537	16mm	11mm	$3.25



GORE HILL OPEN SATURDAY AFTERNOON UNTIL 4 pm

HAND HELD CASE FOR DIGITAL PANEL METERS

This case was originally developed for hand held digital multimeter. This project is now unavailable but we still have a few cases left. The case has a slide away compartment for a 9V battery.
Most 31/2 digit DPMS will fit.
Size: 110(L) x 80(W) x 20(D-front) x 30(d-rear)mm.

Cat. QP-5515
$5.50

DIRECT IMPORT LOWER PRICES BREADBOARDS

Jaycar now direct import Breadboards, so we have dropped our prices, as well as introducing a new model.

Type	Cat	Price	Old Price
100 way	PB-8810	$ 3.75	
640 way	PB-8812	$10.75	$13.95
840 way	PB-8814	$17.50	$22.50
1680 way	PB-8816	$39.95	$49.95
2420 way	PB-8818	$57.50	$69.95
NEW			
3100 way	PB-8820	$69.95	

LOWER EVERDAY PRICES ON CENTRONICS AND 'D' CONNECTORS

These are NOT a special for one month only, they are our EVRYDAY NEW PRICES

WERE	TYPE	1-9	10 UP	100 UP (inc tax)	CAT NO
$2.75	9 pin Male D	$2.25	$2.00	$1.20	PP-0800
$3.50	9 pin Female D	$2.75	$2.50	$1.60	PS-0804
$2.20	9 pin Backshell	$1.90	$1.80	$1.20	PM-0808
$3.25	15 pin Male D	$2.50	$2.25	$1.40	PP-0820
$3.95	15 pin Female D	$2.75	$2.50	$1.60	PS-0824
$5.75	15 pin Female R/angle	$3.50	$3.25	$1.80	PS-0826
$2.20	15 pin Backshell	$2.00	$1.80	$1.25	PM-0828
$3.95	25 pin Male D	$2.95	$2.70	$1.70	PP-0840
$5.25	25 pin Female D	$3.50	$3.20	$1.80	PS-0844
$2.20	25 pin Backshell	$2.00	$1.80	$1.25	PM-0848
$12.50	25D IDC plug	$8.50	$8.00	$6.00	PP-0842
$12.50	25D IDC Socket	$9.00	$8.50	$8.25	PS-0846
$12.50	Centronic Plug	$7.50	$7.00	$5.00	PP-0890
$12.50	Centronics IDC Plug	$8.50	$8.00	$5.75	PP-0892
$15.95	Centronics Socket	$9.95	$9.50	$6.75	PS-0895
$17.50	Centronics IDC Socket	$12.50	$11.50	$8.00	PS-0896

SAVE UP TO 40%

SPARE UV TUBES

After many requests, we now stock the 4 watt fluro tube for our very popular EPROM Eraser. The tube is germicidal quality, made in Japan and is a standard tube. Whilst it could be used on its own (with 4W ballast choke) it is not recommended for that purpose as the strong UV light it emits is very dangerous to human eyes.
Tube measures 145 long x 15 dia.

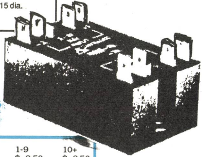
Cat. XE-4951 **$19.95**

YET ANOTHER SCOOP PURCHASE!

UNBELIEVABLE PRICE ON SOLID STATE AC MAINS RELAYS!

Now you can switch up to a 40 amp 240 volt load with TTL device at a fraction of normal cost!
That's right, Jaycar has another scoop buy where you get an incredible product at a price which you can now afford!
A solid state relay is a product that everyone will need one day. They are capable of switching extremely large AC loads with tiny signals that are dielectricaly isolated from the AC load. Even if you don't need one right now you would be crazy not to take advantage of the price while they last.
We honestly doubt whether we will ever be offered stock like this again.
Each realy comes with complete data sheet (if requested). A special heatsink is required for the relay to work at full current but any heatsink of suitable size that has a small flat area will do. They even work well without a heatsink! (E.g. the 10A SSR will work at 5A with no heatsink at 20 degrees C).

DIRT CHEAP!!



BRIEF SPECS:

- Load currents rated to 30C, using adequate (or recommended) heatsink
- On-state voltage drop @ rated output 1.75V Max.
- Off-state leakage @ 600V and 100C: 20mA
- Opto-coupler iso rating 3750V
- Output impedance 500 ohms
- Overall dimensions 72 x 43 x 37mm - Compact!
- Rugged moulded case with heatsink face and either 1/4" Q.C. or 3.5mm screw mounting

Cat	Description	1-9	10+
SY-4080	10 AMP (RMS) Screw Terminals	$ 9.50	$ 8.50
SY-4082	10 AMP (RMS) 1/4" Q.C. Terminals	$ 9.50	$ 8.50
SY-4083	15 AMP (RMS) Screw Terminals	$12.50	$10.50
SY-4084	15 AMP (RMS) 1/4" Q.C. Terminals	$12.50	$10.50
SY-4086	30 AMP (RMS) Screw Terminals	$14.50	$12.50
SY-4088	40 AMP (RMS) Screw Terminals	$19.50	$17.50
SY-4090	Heatsink for 10 amp relay	$10.00	
SY-4092	Heatsink for 15 amp relay	$10.00	
SY-4094	Heatsink for 30 amp relay	$15.00	

NEW

SQUEAKY CLEAN MAINS FILTERS

2 MODELS - FULLY APPROVED

4 OUTLET

The MS-4020 will supply up to 4 appliances. Each 240V socket is independently filtered from the other, i.e. interference from disk drives is de-coupled from the CPU power supply, etc. The filter will suppress interference from RF sources, spikes, transients and lighting, and supply up to 4 outlets with a total load of 10 amps.

Cat. MS-4020

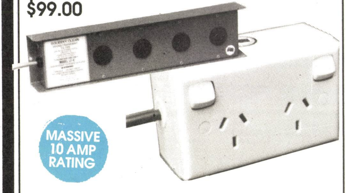
$269.00

2 OUTLET

The two outlet will handle up to 7.5 amps and will suppress interference from RF sources, spikes, transients and lighting. The two sockets are not independently filtered.

Cat. MS-4025

$99.00



MASSIVE 10 AMP RATING

IEC-TYPE MAINS INPUT FILTERS

3 AMP

The filter is rated at 250V 3 amps. 1/4" Q.C. type terminals are on the top for simple internal mains connection. Type IEC-320 recessed chassis plug on the side.

SPECS
115-250V AC input
47 - 63Hz
3A continuous
Size: 38(D) x 63(H) x 50(W)mm excluding terminals.
Cat. MS-4004

$19.95 ea

10 up $17.95 ea

4 AMP

Basically the same as the 3 amp model - fused (3AG) and 4 amps.
Cat. MS-4006

$29.95

8 AMP

For those big jobs
Cat. MS-4005

$29.95

NEW

THIS TIME - A POTCORE PACK!

Potcores are expensive! Potcores are hard to get!

The cost price of our FX2243 (Cat. LF-1260 $17.50) has doubled! This core will soon need to sell for over $30. Which makes our new pot pack an incredible bargain!

This is what you get as an ABSOLUTE MINIMUM.

- 2 x pairs Mullard LA-1219 26mm dia pot cores AT LEAST one bobbin to suit.
- 2 x pairs Philips/Mullard P3019 30mm cores (H5A material A-1000) at least 3 bobbins to suit.
- 1 x pair (or similar) P1814 18mm core H5A
- 3 x pair EP cores 21.5(H) x 24(W) (H5C2)
- 2 x EP bobbin (for smaller core, will not fit above EP core)
- 10 min ferrite adjusters for potcores
- PLUS a quantity of cores to make RF chokes, noise filters etc.

Cat. LF-1280
ONLY $9.95

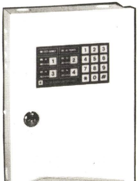
WELL OVER $40 VALUE FOR ONLY $9.95!

4 SECTOR ALARM PANEL

Our new alarm panel incorporates the latest in electronic circuitry and the most up to date security technology. The unit has 4 independent sectors.
Sector 1 is a 24 hour circuit which means that sector is on even when the alarm is turned off. You can protect a siren cover plus outside buildings.
Sector 2 is a perimeter instant circuit.
Sector 3 is an interior instant circuit.
Sector 4 is an interior delay circuit.
All sectors will accept both NO and NC sensors. All sectors can be independently isolated from touch panel. All sectors run with "end of line" resistor, which means if a wire is cut the alarm will go off. It's switched on/off by a 4 digit code, which has 5,040 combinations.
We believe this is one of the best alarm panels we have evaluated.
The best thing is the price. Other companies sell a 4 sector panel with LESS FEATURES for $299.

SPECIAL INTRODUCTORY PRICE

ONLY $259
and for September only FREE 1.2A Back-up Battery worth $28.50.
Cat. LA-5170



ADD TO THIS
Our Fabulous "Pulse Count Triggering" Passive Infra-Red Detector and you have a TOP burglar alarm

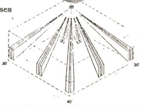
NEW

The absolute latest technology is used in this PIR. It employs a pulse count triggered circuit which virtually eliminates false alarms. The circuit first senses an alarm (Pulse 1) and then goes into an alarm standby mode for 30 seconds. If during this period a second alarm event occurs (Pulse 2) the unit goes into alarm mode and the standby period is extended a further 30 seconds. If there is no alarm pulse during this 30 seconds the unit returns to normal condition. Also suitable for single shot triggering.
Cat. LA-5019

$139.00

OR SAVE $10 on our economy PIR. . .

The ideal unit to add to an alarm system. IR units such as this unit do not respond to non-heat radiating objects - even the cat is unlikely to trip this unit. When a human passes the lens the unit will selectively pick up IR radiation and then not. A series of pulses are then sent to a detector unit.
FEATURES:
12V DC powered
Double sensor
Computerised OC to lower failure rate
Built-in test lamp
Alarm output SPST 30V DC @ 1Amp
Cat. LA-5017



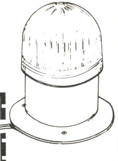
ONLY $99

ALARM STROBE FLASH

Wire this in your house alarm to strobe when the alarm triggers. Gives visual warning as well as your usual available one.
Operates on 12V DC drawing only 150mA.
Blue in colour with screw mounting base.
Flash rate about 120 per minuute.
Cat. LA-5300

ONLY $39.95

NEW

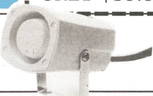


2 MELBOURNE STORES
49 A'BECKETT ST - CITY 663 2030 &
887 SPRINGVALE RD - MULGRAVE 547 1022

TWEETY PIE

This incredibly little piezo screamer measures 57(L) x 33(H)mm and emits a 116dB wail. It's deafening!! As usd in the screamer car alarm kit.
Cat. LA-5255

ONLY $16.95



AT LAST DIRECT IMPORT

HOOK-UP WIRE ON 25 metre ROLLS

Now all hobbyists can afford to have a roll of each colour hook-up wire by their workbench. Quality 13/0.12 tinned hook-up wire on plastic spools.

Red	Cat. WH-3000	Yellow	Cat. WH-3004
Black	Cat. WH-3001	Green	Cat. WH-3005
Brown	Cat. WH-3002	Blue	Cat. WH-3006
Orange	Cat. WH-3003	White	Cat. WH-3007

$2.95 per reel

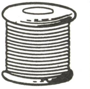
SPECIAL INTRODUCTORY OFFER

Buy one roll of each colour - 8 rolls in all for only

$19.95

SAVE $3.65

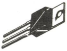
8 pack Cat. WH-3009



LOW COST SCR BARGAIN

We have a small quantity of TELCOR (U.S.) brand 200V 8A TO-220 SCR's. They are not a stock line so once sold they will be gone forever. Part No. S-2008L.
Cat. ZX-7015

$1.50 ea

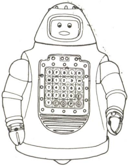


ROBOT SENSATION! SAVE OVER 50%

FEATURES:
- Tactile bumper sensors
- LCD 'Face' which has different expressions
- Infra red sensor - sees in the dark
- 25 key alphanumeric keypad
- 2 speed gears, etc,
- Call in and see one

Cat. XR-1030

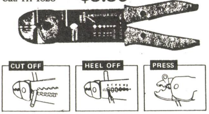
$99



DELUXE CRIMPING TOOL

Handy crimping tool for all your lugs. Much easier than soldering. Also cuts and strips wires.

Cat. TH-1828 **$5.50**



NEW DC PLUG ADAPTORS

PA-3670 2.1mm DC socket to 1.3mm DC plug
$2.20 ea - 10 up $2.00 each

PA-3672 2.5mm DC socket to 1.3mm DC plug
$2.20 ea - 10 up $2.00 each

ILLUMINATED ROCKER SWITCH

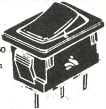
- Great for amps
- SPDT, 8A, 240V
- Illuminated actuator
- As used in P/Master 60/60
- Size 21 x 15mm
- Panel cutout 13 x 19.5mm

Cat. SK-0985

Catalogue price

$7.50 each

$3.95 ea 10 up $3.25 each



CLOSEOUT SALE OF GENERAL INSTRUMENT CHIPS

Your LAST CHANCE (in most cases) to grab a spare of these hard -to-get IC's.

Each IC is supplied complete with data sheet (if requested). We emphasise, however, that once these devices are sold we do not have recourse to further stock. Stock is ONLY held at Concord. It must be orderedin from our stores.

GI Part No.	Descr	Price
AY-1-5050P	7 stage frequency divider	$2.00
AY-3-9400	Dual tone multi frequency generator	$1.00
AY-5-9100	Push button dialler (20 digit)	$2.00
AY-5-4007	4 digit counter/display driver	$10.00
AY-5-9510	CMOS clock generator	$5.00
AY-3-8760-1	Motorcycle game (525 line?)	$4.00
AY-3-3550	4.75 digit multimeter/counter autoranging	$10.00
AY-1-0212T	Top Octave generator* (we don't know what the T-suffix means)	$20.00
AY-1-1320	12 key IC Piano keyboard with sustain & loudness velocity facilities	$10.00

NEW

(*Electronic piano chip)
(AY-1-0212, AY-1-5050 & 5 x AY-1-1320 will give you the basic electronics of a 5 octave touch sensitive electronic piano.

DISK STORAGE CASES

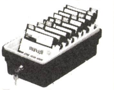
JUMBO 51/4" DISK STORAGE

If you've got lots of disks, you'll appreciate the exrta capacity of this unit when it comes to locating "that" disk.

FEATURES
- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 dividers/spacers

Cat. XC-4765

ONLY $24.95



51/4" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost.

FEATURES
- 70 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. XC-4760

ONLY $19.95

NEW

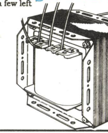
COMPUTER TRANSFORMER BARGAIN - another Jaycar Scoop

We have purchased limited stocks of a power transformer ideally suited for a computer power supply. It has 4 secondary windings which provide the following DC power:
+15V @ 1 amp; -15V or (12) @ 0.5 amp; + or - 18/24V @ 1 amp; +5V @ 6 amps. Total 100VA. A flux shorting strap is also fitted.
Cat. MM-2030 (Due to weight - P&P $5 sorry!)
Normally a transformer of this quality would be around $50 - but for this month you can grab one for a measly -

$5.00!!!!

That's right FIVE DOLLARS

Only a few left



VIATEL TERMINALS FEW LEFT AT ONLY $399 BE QUICK

See our past ads for details

CORDLESS PHONE

Our great new Cordless Phone has a built-in intercom for communication between base and handset. Fully Telecom approved, this phone has all the features one would expect in a top line cordless phone. Drop into one of our showrooms and check them out.

Cat. YT-7068

ONLY $299.00

POTENTIOMETER LUBRICANT

A specially formulated lubricant designed for slider pots.
Can be used safely with metal to metal, metal to plastic, and plastic to plastic parts. The anti-friction properties will ensure the controls will not stick.
Ideal for lubrication of parts under pressure.
Cat. NA-1012

NORMALLY $7.95

SAVE $2.00

ONLY $5.95

IC SUBSTITUTION MANUAL

We believe this book on IC substitution is about as good as they come - for any price. How would you like a single book to list all the current IC products from 108 of the western worlds IC manufacturers! National Semiconductor, for example, lists 19 pages (4 columns/page) of their products, Motorola 19 pages, RCA 9 pages and Texas 18 pages. Many obscure (to Australia) manufacturers are listed. And, that's only 1/2 the book! The other half of the book lists the generic number of the IC. 358 pages. Cover 190(W) x 262(H)mm
Cat. BM-4552

ONLY $39.95

UP-TO-DATE WORLD TRANSISTOR COMPARISON TABLE

Not a table - a great thick book! 784+ pages of transistor equivalents. The book lists all transistors in strict alphanumeric order. Each device is described briefly by its prime maker, material, polarity, case type and lead configuration, function and whether a complimentary version exists. Suggested equivalent parts are also listed.
This book stands apart from other equivalent books because it actually gives data on the component in question. 790 pages. Cover 110(W) x 145(H)mm

ONLY $29.95

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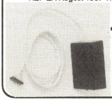

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K7: A switch-tuned radio in a cassette box

Fancy building your own AM radio? Stay tuned. This very compact radio has switched tuning and runs from a single 1.5V battery cell. All you need for this "Hey, what have you got there!" project is an old cassette box and a handful of components.

by HENK MULDER

Gazing into those glossy catalogues, kindly spread around by the hifi shops, you wonder how on earth anyone can manufacture and sell a walkman-type AM/FM radio with headphones for less than 20 dollars. Looking at the price of components you would expect them to cost a fair bit more than that. Sometimes it seems that there is no point in constructing one's own electronic equipment, as most of the stuff is commercially available at lower prices.

However, one thing that money can't buy is the satisfaction you get out of building your own and being able to boast to your friends "Look, I built this myself!" You also learn a lot about electronics, too . . .

The trend in electronics has always been towards miniaturisation of components and final products. However, in this "reduction" race, a lot of manufacturers tend to overlook the manageability of their products.

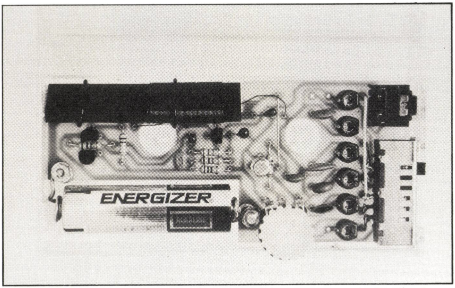
Take a modern TV remote control, for example. Not only do you need good eyes to read the text on the control, you are expected to have some sort of a computer background to understand the operation of the little keyboard. On top of that, using a thumb of average size will often result in more than one number keying at a time. Industry sometimes overshoots the mark.

You will encounter a similar problem trying to tune a modern pocket size radio receiver. The tuning dial is generally so small that tuning is like a jackpot: if you are lucky you will tune in to a good station!

In our new "K7" design we have tried to overcome this problem by providing the radio with 6 presets (a little like a car radio). This restricts the nuisance of tuning to the construction phase of the receiver. Once you have allocated the six positions of the switch to your favourite radio stations, you will find it more than easy to switch from one to the other whenever you get bored with a record, a chat or an advertisement for washing powder.

The K7 radio is powered by a single AA size 1.5 volt battery. The power consumption of the circuit is very low, so the battery should last for quite a while.

Bored with the ubiquitous black "jiffy" project cases, we decided for this project to use the most handled but least applied case — a cassette box. This neat little see-through box supplied us with the name for the project as well. K7, pronounced the French way, says: cassette!



The K7 has switched tuning. The six preset channels are tuned with the six trim capacitors at the right.

AM?

If we are honest about it , then we have to admit that the K7 is nothing but an old-time "crystal" receiver in updated modern disguise. The circuit can easily be split into three parts: the tuning circuit, the detector and the audio amplifier. Have a look at the simplified diagram, Fig.1.

Radio signals are picked up by the antenna, whose coil is part of the tuning circuit. The tuning circuit has a double function; it selects the radio signal for which it is tuned and it suppresses all the other unwanted signals.

How does it work? The tuning circuit or resonant circuit, consisting of a coil (inductor) and a capacitor, resonates at a certain frequency: the resonance frequency. If you inject a signal of this resonant frequency into the circuit, then the energy in the circuit will build up. In other words, the amplitude of the signal in the tuning circuit will get larger and larger. In theory, if the tuning circuit were ideal, i.e., without losses, then the amplitude could become infinitely large . . . However, in practice there are losses: the capacitors leak, the coils have resistance and on top of that the tuning circuit loses energy through electromagnetic radiation. Still the tun-

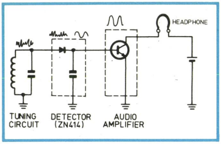


Fig.1: Simplified diagram of the K7 radio.

ing circuit does in effect "amplify" the tuned signal and weakens the other signals.

Back to our simplified circuit. Having picked the radio signal we want out of the ether, it needs to be deciphered or, to stay within the jargon, to be demodulated. As you may know, AM stands for Amplitude Modulation. It means that the amplitude or strength of the radio frequency carrier has been modulated with the audio frequency music or voice signal.

When you physically look at the modulated signal (on a CRO) you will notice that the envelope of this signal corresponds exactly to the original AF signal. Now, to demodulate the radio signal, the most obvious thing to do would be to trace an "electric" line across the envelope. Basically this is what happens in our detector. The diode cuts off half of the symmetrical RF signal and the capacitor smooths out the remaining half cycle pulses into a continuous signal. The RF signal is now demodulated and the audio signal is retrieved.

To make the AF signal audible in the headphones it needs to be amplified, and this is done in the audio amplifier.

All this might seem very basic and simplified, but you should realize that the first AM receivers did not even have an amplifier. They literally had only four components. Yet at the time, they were regarded as hi-tech!

The circuit

As described in the previous section, our K7 cassette box receiver consists basically of three parts: tuning, detection and amplification. If you have a closer look at the circuit diagram (see Fig.2) you will notice that the three sections are separated by the capacitors C13 and C15.

The tuning section is quite straightforward. The inductor L1 (the coil winding on the ferrite rod aerial) is connected in parallel with any of the six tuning capacitor combinations through switch S1. Each capacitor combination consists of a fixed capacitor and a trimmer capacitor. The value of the fixed capacitor determines the frequency range of the tuning circuit and the trimmer capacitor is used for the actual preset tuning. Each of the capacitor combinations should be tuned to different stations, depending on your personal tastes and preferences.

Capacitor C13 couples the RF signals into the next stage, the detector. The AM detector consists of one single IC chip which physically resembles an ordinary transistor. Don't be fooled, the ZN414 does the work of several transistors. To start with it has a high impedance input and buffers the input signal (to prevent loading down the tuned circuit). It then amplifies the weak radio signals, with a typical gain of 72dB — about 4000 times. In the next internal stage, it detects the AM signal; and last but not least, it provides an output buffer for the audio signal.

The output level of the ZN414 would be enough to drive a set of light headphones, although the sound would be quite weak. More of this soon. We have not mentioned the last and most important feature of the ZN414 yet: the Automatic Gain Control (AGC). The strength of radio signals depends entirely on the power of the transmitter and distance of the station, and the difference in the signal level of detected signals can be very big. To get a consistent output level, somewhere along the line the signals should be attenuated or amplified. This is exactly what AGC does, by using the output level to control the gain of an amplifier.

The AGC of the ZN414 radio chip is very effective. The output signal of the ZN414 is fed back to its input via the potentiometer VR1 and the resistor R1. The potentiometer VR1 is used as a RF gain control.

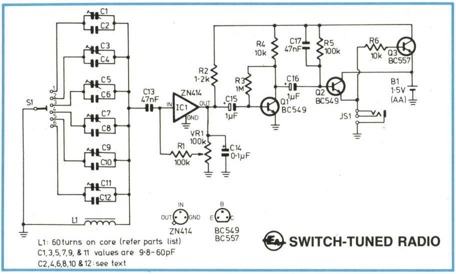
Although the AGC of the ZN414 is very good, it has its limits. If a signal still gets through too strongly, then the signal level can be adjusted with VR1. You basically reduce the feedback DC voltage, which will fool the AGC which then reduces its gain. If a signal is too weak, then VR1 should be adjusted in a way that the DC feedback is increased.

When you are receiving very strong signals then it is possible for the ZN414 "to go crazy" and start protesting in your ears. The obvious remedy for the problem is to decrease the gain.

This may all sound very confusing and complicated, but really we are only talking about one single potentiometer which has to be adjusted; in practice it's quite easy to use. Resistor R2 determines the RF gain of the ZN414 and capacitor C14 filters out the remaining RF and determines the time constant of the AGC. Capacitor C15 blocks DC, and leads both us and the AF signal to the audio amplifier stage.

The 1.5V supply voltage does not allow a great "working space" for audio amplification. The output level is quite reasonable especially when you use the "in your ear" type headphones. The biasing method used in the first transistor stage protects us against problems due to transistors with different current gains.

This first transistor stage amplifies the AF signal to an acceptable level. The signal is then fed into the buffer stage



L1: 60turns on core (refer parts list)
C1,3,5,7,9, & 11 values are 9·8-60pF
C2,4,6,8,10 & 12: see text

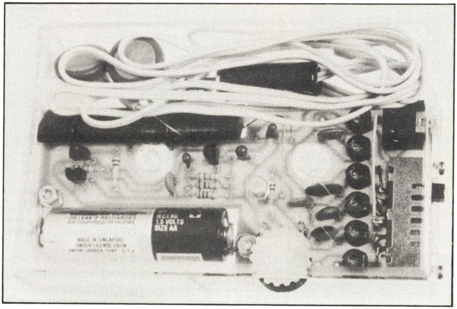
EA SWITCH-TUNED RADIO

Fig.2: The three main sections — tuning circuit, detector and audio amplifier — are separated by C13 and C15 respectively.

(Q2) via capacitor C16. Resistor R5 biases transistor Q2 and the parallel capacitor C17 filters off the higher frequencies, which contain a lot a noise etc. Finally the amplified AF signal is fed into the headphones.

The circuit is provided with a stereo phono socket so that people who want to use their own stereo headphones will hear the sound from two sides instead of one. The sound from such a simple receiver is obviously mono, even if you are tuned to a stereo AM station.

The PNP transistor Q3 acts as an electronic On/Off switch. When the headphones are plugged in then the base circuit of Q3 is closed and the transistor is turned on. The voltage drop over the emitter-collector is only about 100mV.



The K7 is very compact: even the headphones fit into a standard compact cassette box.

Selecting the frequency range

The resonant frequency of the tuning circuit is determined by the ferrite rod coil L1 and the parallel connection of the trimmer capacitor C1 and capacitor C2 (when the switch S1 is in position 1).

The trimmer capacitors have a range of 9.8-60pF. To get the radio tuned into the right section of the AM band, you have to add the fixed parallel capacitor C2 into the circuit. Table 1 gives the values for the parallel capacitors C2, C4, C6, C8, C10, C12 for the required frequency ranges.

Frequency range kHz	C2, C4 etc. pF
1200 — 1600	0
950 — 1200	56
800 — 950	120
725 — 800	180
675 — 725	220
625 — 675	270
600 — 625	330

Table 1: Values of parallel capacitors for the different frequency ranges.

Needless to say, select the values you need for C4-C12, depending on the particular stations you want to tune in.

It is advisable to determine the values of these capacitors before purchasing the components or actually assembling the PCB. The ceramic disc capacitors are very cheap and it might be worth to buy a few extra values, in case you change your mind on the range.

Construction

The printed circuit board (PCB) for the K7 project has quite an odd shape, to suit the cassette box. Two holes are provided so that you won't have to remove the two plastic projections (the tape blocking mechanism) from the cassette box. The two other cut-outs are meant for the battery and the ferrite rod coil. The PCB is coded 87mc9 and measures 106 x 47mm.

Before assembling the PCB, you have to modify the cassette box. The mechanical details of the modifications are given in Fig.3. The hole for the headphones socket has to be drilled, then a file used to work out the spaces for the switch and the potentiometer.

Most cassette boxes have little plastic bits at the insides. To make the PCB fit, those bits have to be taken out. This is best done with side cutters.

Make sure that the PCB easily fits in the cassette box. If the PCB has been cut off too large, then it will have to be pruned down with a file.

The order of assembling is the same as for most other PCB's. First the wire links, then the resistors, the capacitors and finally the transistors and the AM radio chip.

The 6-position switch has to be mounted before the trimmer capacitors. The switch is not directly mounted on the PCB, but via small wire links. The best approach is to solder the wire links first to the PCB, and then bend and cut them so that they can be soldered directly to the switch.

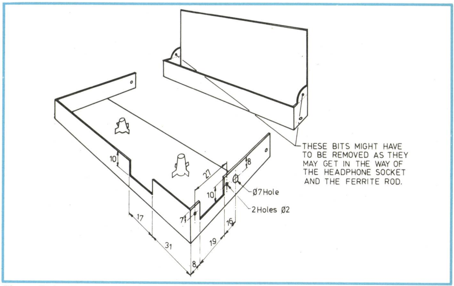

THESE BITS MIGHT HAVE TO BE REMOVED AS THEY MAY GET IN THE WAY OF THE HEADPHONE SOCKET AND THE FERRITE ROD.
Ø7 Hole
2 Holes Ø2
10
27
18
10
7
17
31
19
16
8

Fig.3: This diagram shows the modifications required for the cassette box, to suit the K7 PCB.

The trimmer capacitors, headphones socket and trimpot can now be mounted. The trimpot we used is of the vertical mounting type mounted horizontally, as the horizontally mounting trimpots with a knob are difficult to get. The middle leg of the trimpot is directly mounted on the PCB, and the outer legs via wire links.

The battery clips are home-made and take a bit of craft work. They are made of tinned copper wire, artistically bend into two circles: one circle is the battery contact, the other is mounted to the PCB with the screw. The battery clips are a bit fiddly to build and a couple of miniature fingers would come in handy.

The next step is to wind the coil on the ferrite rod. The ferrite rod we bought from Dick Smith was supplied with a coil, but we didn't use it. Perhaps you have an old ferrite rod laying about, the only important specification is the size. The coil is wound with 60 turns of 0.4mm enamelled copper wire.

Parts list

1 PCB coded 87mc9, 47x106mm
1 compact cassette box (Maxell, TDK etc.)
1 6-position switch (DSE S-2050 or similar)
1 3.5 mm stereo PCB mount phono socket (Jaycar)
2 2.5 mm screws, nuts and washers
1 1.5V battery (AA)

Semiconductors

1 ZN414 AM radio chip
2 BC549 NPN transistors
1 BC557 PNP transistor

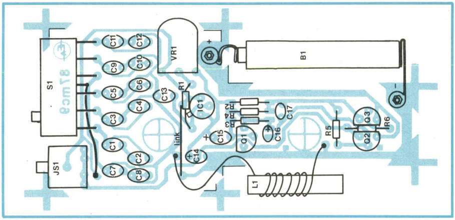
Capacitors

6 trimmer capacitors 9.8-60pF (brown)
2 47nF disc ceramic
1 0.1uF tantalum
2 1uF tantalum
6 disc ceramic in range 82-390pF, see text

Inductors

1 Ferrite rod aerial, rectangular 55x13x5 (DSE L-0520)
3 metres of 0.4 mm enamelled copper wire 0.4

Resistors (0.25W, 5%)
1 x 1k2, 2 x 10k, 2 x 100k, 1 x 1M
1 100k trimmer potentiometer (Tandy)



Follow this wiring diagram when assembling the PCB. Take care with the orientation of the capacitors and transistors.

The wire ends of the coil can be fixed to the ferrite rod with a bit of glue or sticky tape. The wire is enamelled and the ends have to be scraped clean with a bit of sandpaper or a knife (take care not to cut it).

The ferrite aerial rod with coil is mounted to the PCB with two bits of insulated wire through the holes in the PCB. An ordinary reef-knot will secure the rod (don't solder the ends together as this will act as a shorted turn). You can now solder the wire ends of the coil to the PCB, according to the wiring diagram.

Testing and adjusting

By now the K7 should be ready for testing and aligning. All the testing should be done with the headphones on (in) and plugged in. Firstly put in the battery. Mind the polarity of the battery- the "+" points at the potentiome-

Hertz and beer

This year we are celebrating the centenary of radio. It was in 1887 that the bright German physicist Heinrich Rudolf Hertz experimentally proved that Maxwell had been right when he predicted the existance of electromagnetic waves some 23 years earlier. Hertz did his experiments in his laboratory in Karlsruhe, Germany. He used a spark-gap transmitter and a loop antenna with a gap as receiver. His very basic radio set would nowadays probably destroy the input amplifier of your FM tuner, but at the time it was good enough to generate and pick up radio waves over a distance of a couple of metres. Hertz published his sensational findings in a series of papers between 1887 and 1889.

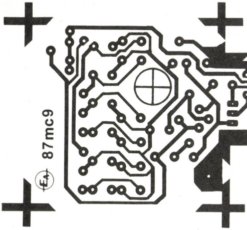
Hertz's discoveries inspired many of the contemporary physicists. Some of those scientists came up with appreciable results and the invention of wireless communication was claimed by several people like Sir Oliver Lodge from England and Alexander Popoff from Russia. However, at the end of the race it was the young Italian Guglielmo Marconi from Bologna who was awarded in 1909 with the Nobel Prize for Physics. Not without reason, for by 1909 Marconi had done a lot of pioneering work. In 1896, at the age of 21, Marconi managed to telegraph messages over a distance of 2.5 kilometres. In 1899 he bridged the English channel and two years later an Atlantic radio link was laid between Poldhu, Cornwall and St. John's, Newfoundland.

Now, a hundred years later we find the word Hertz in the dictionary and I fear that most people have forgotten that it used to be the name of a clever physicist of the past.

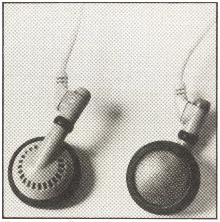
During those hundred years of radio, a lot has happened. The valve has been invented, the transistor, the computer has been introduced and at the moment we are decorating the sky with satellites.

History is being made all the time and who knows, perhaps at this very moment, a bright young technician is on the verge of inventing something that will have an impact as great as the invention of radio.

For the time being, as we are celebrating today, I would like to say: Cheers Hertz, zum wohl!!



An actual size reproduction of the PCB artwork.



"In your ear" type headphones.

ter. It might be worth writing a "+" and a "-" at the appropriate places, this to avoid mistakes in future days.

Having put in the battery, you have to adjust the trimmer capacitors. It is best to start testing with "full power", i.e. the potentiometer fully turned clockwise.

To adjust the trimmer capacitors you should preferably use an isolated screwdriver — in order to not influence the tuning circuits too much. You can now adjust each tuning position. Note that the position of trimmer capacitors does not correspond to the switch position. Counting from the left to the right the switch positions 1 to 6 correspond to the trimmer capacitors 4, 1, 2, 3, 5, and 6.

As mentioned before, it is possible that very strong stations will distort. In that case you should lower the gain with the potentiometer.

In practice it is not difficult at all to align the tuning capacitors. Once you have done it, your K7 is programmed for life.

The K7 in everyday life

The switched tuning of the K7 radio is a very useful feature. While listening to this little radio you'll find it very easy to change from station without the difficult tuning which generally take a bit of attention.

If you use the "in your ear" type headphones — which gives the best performance — then you can use the empty space of the cassette box to transport them. How's that for a good design! EA

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PN3569	.18	.16	PN3639	.18	.16
PN3640	.18	.16	PN3641	.11	.09
PN3642	.11	.09	PN3643	.11	.09
PN3644	.15	.13	PN3645	.15	.13
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PN4356	.19	.17	MPSA42	.20	.15
MPSA43	.11	.09	MPSA55	.18	.17
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W12626	26 Way	34.00	32.00	29.00	26.00
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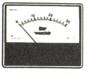

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Z10107	IN4004	0.05	0.04	0.03	.025
Z10110	IN4007	0.10	0.06	0.05	0.04
Z10115	IN5404	0.18	0.14	0.09	0.08
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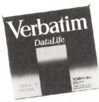

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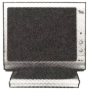

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R15152	.022uF	0.07	0.05	.04
R15154	.033uF	0.07	0.05	.04
R15155	.039uF	0.07	0.05	.04
R15156	.047uF	0.08	0.06	.05
R15157	.056uF	0.08	0.06	.05
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R15159	.082uF	0.08	0.07	.05
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Finding your way in

Telephone toyland

Now that there are so many telephones, modems, faxes and other communications devices available for connection to the telephone network, it's very useful to have a basic understanding of telephone operation and the correct connections. Here's the lowdown.

by STEWART FIST

It's getting much harder these days to tell a telephone from a computer. The traditional role of those twin wires linking your home and office to the outside world has been changing — and things will change even more in the coming years.

The telephone system is being modified from both ends. The traditional telephone handset is being supplemented by communicating computers, fax machines, teletext and modems, while at the exchange, digital transmission and switching technologies are taking the system in new directions. Packet Switching and Datel services have been with us for many years, and ISDN (Integrated Services Digital Network) is due for introduction early in 1988.

When you look back over old issues of *Electronics Australia* or any of the other electronics and computer magazines published in Australia, you find very few articles deal with telephones. Telecom have been very effective in erecting a "no trespass" sign over Australia's telephone system, and their monopoly control has ensured that very little has been published.

Consequently, many of us have learned about radios, amplifiers, television, computers, and even satellite communications, without knowing more than the basics about the most ubiquitous and most popular of all our communications technologies.

Now that Telecom's total control of the telephone system has been broken we need to know more. You can now connect non-Telecom modems, handsets and other equipment to the telephone lines without breaking the law . . . as long as these instruments comply with Telecom's technical specifications.

This is fair enough. Telecom have a responsibility to ensure that users don't accidentally or inadvertently feed 240 volts down the line and electrocute a few exchange workers. From the experimenter's point of view, it is probably also best if they don't call attention to their trials by burning up expensive switching gear!

So, let's have a look at the telephone system and try to understand the dos and don'ts.

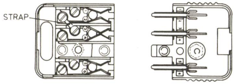
A standard single telephone set-up will usually have two pairs of incoming wires within the one cable. They are colour coded red/black and blue/white, but only the blue/white pair of these is actually used.

There is a DC voltage (of about 50V at the household end) across this pair, with the white having a positive polarity. The lines terminate at a standard 6-point Telecom socket, with the white going to contact 2 and the blue to contact 6.

If you open up the first socket in your household system, you will probably find a strap joining contacts 2 and 3, but this strap might not exist in extension sockets. Telecom's practice is to bring all signals into the premises on only two wires, then split into four after the first socket.

Traditionally, extension links extend from the first socket and create a parallel chain joining together all socket contacts 2 (white), contacts 3 (red), contacts 5 (black), and contacts 6 (blue). See Fig.1.

It is important that the strap between 2 and 3 is retained in the first *socket* so that an electrical connection between the two lines remains, even if the telephone is removed from this socket. This is essential with the Telecom-supplied Colorfones and Touchfones — from the plug on they have two separate circuits; the white (contact 2) connection for voice and dialing, and the red (contact



Above shows the construction of the standard 6-way plug and socket as used by Telecom and the majority of devices connected to the Australian switched telephone network — like extension phones, modems and fax machines. The connections are numbered from 1 to 6, from top to bottom as shown, with 2 and 3 often strapped together.

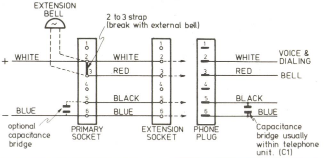


Fig.1: The basic connections for a primary socket, extension socket and telephone. The incoming line terminates at pins 2 and 6.

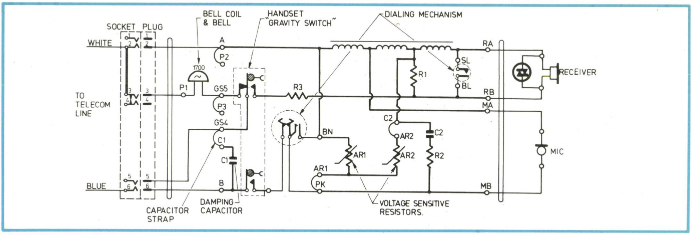


Fig.2: The circuit of a standard Telecom 800-series "Colorfone", which generally forms the basis for most subscriber services. An understanding of its basic operation helps when you're working with modems and other devices.

3) which provides the links for bell signalling.

Note however, that the bell current still exists at contact 2 and in the voice circuitry; most of the small push-button telephones you can buy use only contacts 2 and 6. The standard Colorfone (No.802) and Touchfone (Nos.805 and 806) require the four-wire link to the handset.

Contacts 5 and 6 are not strapped in the primary socket, but they are coupled by a large electrolytic capacitor within the first telephone — we'll deal with this later.

Contacts 2 and 3 can be strapped together at the primary socket and at all extension sockets in most cases. However if you want to add a special extension bell, this is usually done across the primary socket contacts 2 and 3, and the connector strap/s must then be removed. The extension bell then sits in series with the bell of the handset/s, and it creates the necessary linkage between the two wires.

The linkage between contact 5 and 6 is via a 0.75μF electrolytic capacitor (C1 in Fig.2). This is the damper capacitor that handles the AC component of the bell signal, but blocks the DC.

The capacitance across the incoming lines is not especially critical, but you don't want to double it or triple it by adding extra phones. Telecom technicians at the local exchange measure and record the total line capacitance, to monitor whether additional items are being hung on their line. In the past, a sudden doubling of the capacitance would trigger a visit from an inspector looking for the illegal extension phone.

If you have a number of extension sockets but only one moveable phone, these contact connections aren't modified at all. However, if you have two or more Colorfones or Touchfones on the same line, the extensions should be modified to remove the extra capacitance from the circuit. This is done by removing the internal strap between two contacts at the back of the phone, GS4 and C1. All contact points in the diagram (Fig.2) are prominently marked on the telephone's circuit board.

These changes assume that the first phone in the system will supply the necessary capacitance, but if this is to be a moveable phone then it is conceivable that it may not be in circuit when needed. To be sure, it is best to disable all internal capacitors and to fit a permanent external one between contacts 5 and 6 behind the first telephone socket.

Dial phones work by breaking and making the DC line current across the incoming "twisted pair". When you pick up the handset to dial out, the "gravity switch" ("GS" in Telecom's schematic code) creates a direct short across the incoming pair through the dial mechanism.

At the telephone exchange a linefeed concentrator which scans a number of incoming lines, detects the voltage change; at this point you will get the artificially generated dialling-tone in the handset.

If you now dial say the number 5, there are five 70ms "break" pulses transmitted down the line, and these are used to activate the first "group" selector. After a pause of about 200ms, the control will pass to the second selector. How this works depends on the type of exchange equipment, but the procedure is always the same.

The first two or three digits in a telephone number (the "code") identify the destination exchange, and the last four digits (the "numericals") define the location of the subscriber. In the older exchanges these dialled digits are stored in a local register/translator called a "director", with the code being treated separately from the numericals.

By using the code, the director controls the routing arrangements through any intermediate exchanges until it makes contact with the first numerical group selector in the destination exchange. It then switches to repeat the "numerical" digits, to drive the subsequent selectors until the destination line is reached.

The first automatic telephone switching system used a stepping switch invented by a Kansas City undertaker named Almon Strowger, and modified "Strowger" step-by-step exchanges are still to be found around the country.

Later developments saw the introduction of the Crossbar exchange, which used "registers" to store all digits until dialling was complete. A "marker" then takes the dialled intelligence and initiates the connection.

In later exchanges the crossbar switches have been replaced by "ferreed arrays". These are ferrite material with a reed relay encapsulated in a small class envelope and surrounded by an operating coil. "Markers" have also gone through an evolution from simple electronic components to computers.

Nowadays in a modern electronic exchange a scanner "looks" at the lines and trunks periodically to detect changes in state. When you lift the handset to call, space is allocated in temporary computer memory to store the dialled digits. This information is then compared with the translation routing data stored in semi-permanent memory, and a trunk line is selected.

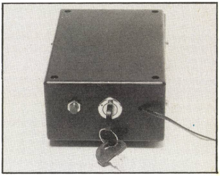
Along with these modifications we also have changes in the dialling methods. Touch-tone (DTMF — Dual-tone multi-frequency) telephones don't use a

Continued on page 121

Improve the protection of your house or car with this

Satellite siren

Building this low cost unit and adding it to an existing security alarm system will give greatly increased protection. It's easy to build, and is compatible with virtually any alarm — whether commercial or home built. The end result compares very favourably with commercial units costing much more.



by BRANCO JUSTIC

Alarm systems which are approved by organisations such as insurance companies recommend the addition of a backup battery and/or a satellite siren for greatly improved protection. The siren described here effectively provides both of these features, in the one unit and can easily be added to any existing alarm system.

It is operated from only four small nicad penlite cells and uses a solid state DC-DC converter to provide the necessary voltage (12V) to power a mini piezo siren. The resultant inexpensive unit is able to power the siren continuously for more than 30 minutes. It's charging system only consumes about 10mA from your power supply or vehicle battery.

Alternative alarm systems

Car alarm systems are usually built around one of the following three arrangements:

(1) Single central control unit without battery backup.

(2) Central control unit with backup battery.

(3) Central control unit and satellite siren.

The cheaper systems of course employ a single central control unit. This type of alarm system should be effective with the less professional burglar. Since most thieves fall into this category, many people argue in favour of this type of simple and inexpensive alarm system.

Some of us however prefer the extra protection obtained from a control unit with backup battery. This provides the advantage of still having an active alarm in the event of the main supply being disconnected i.e., the car battery disconnected by the thief.

In this type of system, careful consideration should be given to the placement of the control unit and the siren, in order to make it difficult for the thief to get at. And of course since we are considering a thief who is either a professional, or perhaps a non-professional who doesn't give up easily, the alarm unit with its associated battery, siren and interwiring should be mechanically very rigid, making it difficult to destruct.

As an add-on to a simple alarm system it would be therefore logical to contain the backup battery facility and its associated siren in a rigid enclosure, and it is this combination that is commercially termed as either a "Backup siren" or a "Satellite siren".

The benefits of adding a satellite siren are numerous. Firstly there is the added protection of a self-contained second system. Secondly there is the automatic benefit of "backup battery operation", even if the main alarm does not have this feature; the "satellite siren" will come into action immediately in the event of the supply (e.g., vehicle battery) being disconnected. Also there is a certain degree of protection against a burglar who doesn't hesitate to hack into your system (vandalises). The satellite siren will come into operation if the wiring to the main alarm is cut!

In summary it could be said that an economical system which employs a satellite siren would comprise a simple and easy to get at mains alarm, which is connected to a more rigid and remotely placed satellite siren, like that described here. Some of the locations that could be considered are in the boot, behind the rear seats, under seats which are hard to remove, under the dashboard etc.

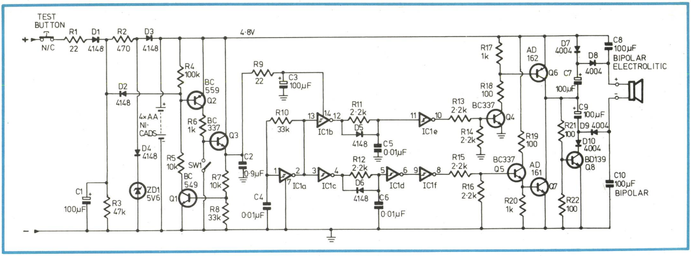
Simple to connect and operate

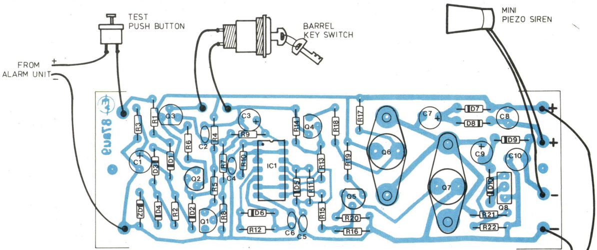
The unit is connected via only two wires to the existing alarm system. The two wires are actually the power supply connections (+ and –), and they are connected to the existing alarm system. Therefore it can be said that the satellite siren derives its power from the existing alarm system.

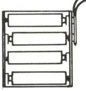
It is in the event of failure of this power that the satellite siren comes into action, sounding its siren continuously. Actually once power failure has occurred there is no way the siren can be stopped, unless you have the key to switch the unit off. Even the restoration of power to the unit does not stop it.

How it works

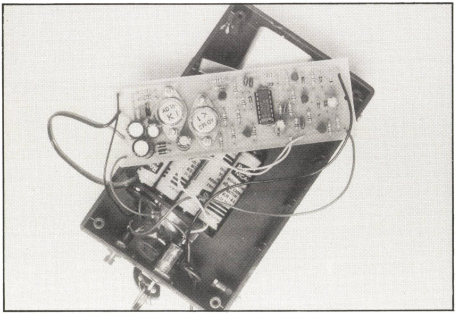
In basic terms, the siren uses a combined battery charging and voltage drop detector circuit to charge the batteries







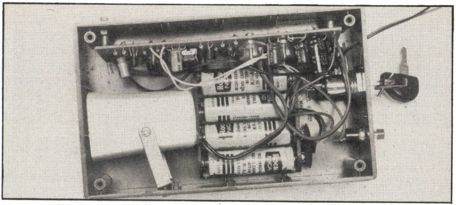
The complete circuit for the satellite siren is at top, with the wiring diagram above. Note the inbuilt NiCad battery and piezo siren.



Inside the prototype, with the PCB swung out so you can see the components. The NiCad cells and siren are visible underneath.

and activate a latching circuit, in the case of the power to this unit being interrupted. The latching circuit when operated enables an oscillator which in turn drives switching transistors to produce an AC output voltage. The AC output from this stage is then applied to a voltage multipler circuit which produces sufficient output voltage to drive the 12V piezo siren. Once the latching circuit is operated the only external way of stopping siren operation is by operating the key switch (SW1).

In more detail, the input voltage which is derived from the main alarm is applied via R1, D1, R2 and D3 to the 4.8V nicad battery pack (4x1.2V penlite batteries). R1 and R2 limit the charging



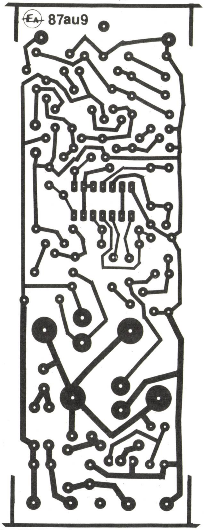
Another view inside the siren, this time with everything in position.

current to approximately 10mA, whilst diodes D3, D4 and ZD1 maintain the maximum voltage available to the battery at 5.6V. This arrangement of components maintains the battery at full charge, whilst preventing the battery from overcharging.

Note that diode D2 is reverse biased when external power is connected to the unit. In the event of the battery being disconnected, C1 will discharge through R3 and after about 5 seconds the voltage across C1 will drop to approximately 3.6V. D2 will then become forward biased, thus turning on transistor Q2, which in turn turns on Q3. The output voltage at the emitter of Q3 provides power to IC1 via a decoupling circuit (C2, C3, R9).

At the same time, the rise in Q3's emitter voltage also turns on Q1, via R7 and R8. The circuit associated with Q1, Q2 and Q3 is now latched on and even restoring power to the siren would not unlatch it.

Diode D1 provides isolation for the timing circuit (C1, R3), from the car's power circuit. The timing circuit was included to prevent false triggering of the satellite siren when the vehicle battery voltage drops to low values under normal conditions, such as peak starting currents with run down batteries in cold weather.



The PC board pattern, actual size.

The Schmitt trigger inverter gate IC1(a) combined with R10 and C4 forms an oscillator operating at approximately 2kHz. Inverters IC1(b) and (e) provide isolation and drive for the switching transistor combination consisting of Q4 and Q6. Similarly IC1(c), (d) and (f) provide isolation and drive for the switching transistor combination consisting of Q5 and Q7.

The network consisting of D5, R11 and C5 delays the subsequent turn on of Q6, whilst D6, R12 and C6 delay the subsequent turn off of Q7. The addition of this time delay assures that transistors Q6 and Q7 are never on simultaneously. This results in minimal dissipation in the output transistors (Q6, Q7), and more efficient operation. It also eliminates the possibility of thermal runaway with the germanium output devices used.

The germanium devices were chosen because of their very low saturation voltage, compared to silicon devices; probably their only advantage.

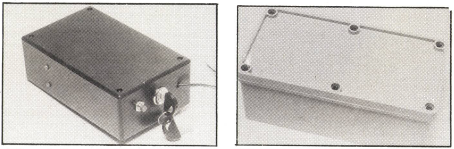
The AC output voltage from switching transistors Q6 and Q7 is applied to two individual "charge pump" circuits. The pump consisting of C7, D7, D8 and C8 raises the output voltage at the positive siren terminal by approximately 3.5V above the internal battery's positive potential. Similarly the charge pump consisting of R21, R22, C9, D10, Q8, D9 and C10 lowers the output voltage at the siren's negative terminal by approximately 3.5V below the internal battery's negative potential.

The additional components in the negative charge pump (R21, R22 and Q8) make D10, Q8 function as an active rectifier; when the siren is off, Q8 is off. Without the addition of this network there would be a path for a direct current from the positive supply via D7, D8, the siren, D9 and D10 to the negative supply, when the siren is off.

Construction

A complete kit of parts for this project is available from Oatley Electronics (see parts list). Most of the parts are mounted on the printed circuit board, and are shown in the overlay diagram. Begin construction by installing all of the parts on the printed circuit board. Watch the orientation of the transistors, diodes and polarised electrolytic capacitors. Also secure the two output transistors with machine screws nuts and shakeproof washers, prior to soldering their base and emitter leads.

The prototype was assembled in an economical 50 x 90 x 150mm plastic case. Individuals may choose to use more rugged metal boxes, or perhaps a



Although the prototype was housed in a jiffy box (left), you could alternatively use a rugged junction box like that shown at right.

very strong electrical junction box such as the one shown. Assemble all the necessary parts into the chosen box as illustrated in our diagram. To test the unit connect power to the unit, switch the key to the on position and remove the power by operating the "Test" push button. After a few seconds the siren should operate and it should continue to do so even if the test push button is released. Switch the key to the off, position and check that the siren stops operating. Of course we are assuming the batteries were fully charged to start with, if this isn't the case, you'll need to connect the unit to a 12V power supply or battery for a while before testing it.

PARTS LIST

1 PCB, code 87ms9
1 Plastic box 50x90x150mm
1 1 Piezo siren (12V — 150mA)
1 AA 4 cell battery holder
4 AA nicad batteries
1 Pushbutton switch (normally closed)
1 Barrel key switch
1 Battery snap connector
Screws, nuts, washers, hook-up wire

1 BC549 Si NPN transistor
1 BC559 Si PNP transistor
3 BC337 Si NPN transistors
1 BD139 Si NPN transistor
1 AD161 Ge NPN transistor
1 AD162 Ge PNP transistor
1 74C14 or 74HC14 integrated CCT (Hex Schmitt trigger)
6 1N4148 Si diodes
4 1N4001 Si diodes
1 5.6V 400mW zener diode

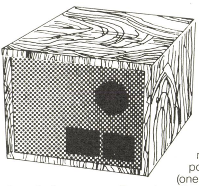
Capacitors

4 0.01uF ceramics or greencaps
4 100uF, 16V electrolytics
2 100uF, 16V bipolar electrolytics

Resistors - 0.25W 5%
2 x 22Ω, 4 x 100Ω, 1 x 470Ω, 3 x 1kΩ, 6 x 2.2kΩ, 2 x 10kΩ, 1 x 33kΩ, 2 x 47kΩ, 1 x 100kΩ

Where to buy parts: a kit of parts for this project is available from Oatley Electronics, 5 Lansdowne Pde (PO Box 89) Oatley, NSW 2223. Telephone: (02) 579 4985.
PCB kit only (with components) — $17.00
Piezo siren — $16.00
Barrel key switch — $6.50
NiCad batteries — $3.00 each
Complete kit — $55.00 (add $2.00 for P&P)

ADD A BASE OCTAVE OR TWO



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Low cost power supply for experimenters

This easy to build power supply is ideal for the experimenter on a limited budget. It features switch adjustable output voltage and current limiting, and uses a standard AC plug pack as a safe power source.

by ROB EVANS

It is hardly surprising that many power supplies have been published over the years, considering their usefulness to the electronics enthusiast or technician. Many of these designs have been quite complex and expensive offering facilities rarely needed by the average experimenter — particularly those just starting out. The main criteria for this project was that it had to be inexpensive and easy to construct, yet offer useful facilities and performance. A tall order perhaps, but the prototype has cost far less than other small power supplies and at least equals their performance.

In this design we have used rotary switches for the voltage and current selection for user convenience, and to avoid the need for expensive panel mount meters.The voltages have been chosen to match common battery types, with a 5 volts "logic circuit" setting thrown in for good measure. The current settings have been selected with protection of the load in mind.

The circuit can accommodate different voltage and current ranges by minor component changes, the only real limitation being the capabilities of the transformer or plugpack used for the AC supply.

Although a common mains transformer (and associated wiring) could have been used, we have selected a plugpack to simplify construction and maintain high safety standards. These units are commonly available with a 12 or 15 volt AC (500 mA) output, which is recommended for this project.

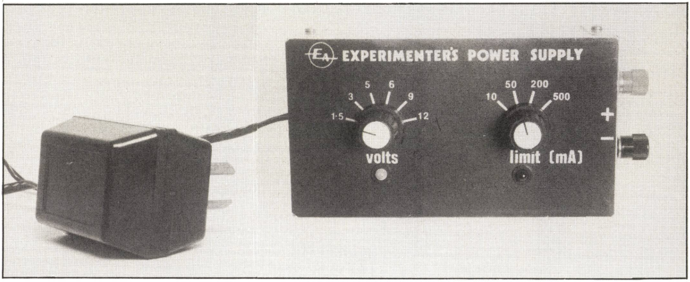
The design

Three-terminal regulators such as the LM317 and the 78xx series were immediately considered due to their availability and low cost, but the circuitry for an absolute current limit became a little complex — and expensive. So we went back to the traditional op-amp and transistor series regulator design.

A relatively standard circuit is used, with a zener diode voltage reference and a current limiter on the output. The latter will never let the output current exceed the selected amount, even under short circuit conditions. Most small power supplies only employ current limiting to prevent overload of the unit itself, whereas this design has a couple of very low settings. Hence your delicate (and often expensive) circuit components need never be at risk!

Circuit principles

The basis of this design as shown in Fig.1 is simply an op-amp (LM741) in a



The supply is built into a low cost aluminium case. An AC plug pack provides total isolation from the mains.

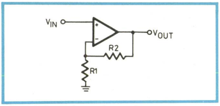
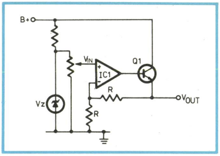


Fig.1 (above): an inverting op amp stage is the basis of the circuit.

Fig.2 (right): the addition of an emitter follower Q1 increases the current capability of the circuit. Also shown is a variable voltage source, twice this voltage appearing at the output.



standard non-inverting configuration, set to a gain of 2:

$$\text{Gain} = \frac{\text{Vout}}{\text{Vin}} = \frac{\text{R2} + \text{R1}}{\text{R1}}$$

So if R1 = R2 then Gain = 2

The output will always drive so as to balance out any voltage difference between the inverting (-) and non-inverting (+) inputs. Therefore a level of say 3 volts at the input will produce an output of 6 volts.

In Fig.2 an emitter follower transistor has been added to increase the current sourcing capability, the op-amp itself only being able to supply about 25mA. Any voltage level changes or non-linearities introduced by the transistor are automatically corrected because it is within the negative feedback loop of the op-amp.

The maximum current this circuit can supply is the op-amp capability multiplied by the gain of the transistor. Or in this case,

I(out) = 25mA x (say)50 = 1.25A

The gain of the transistor can effectively be increased by adding another to form a Darlington pair, which will in turn increase the available current, but for our modest needs this is not necessary.

By adding a variable voltage reference to the input, as shown in Fig.2, the circuit will amplify this by a factor of two, and consequently provide a stable high current output source.

The final circuit

The final circuit (Fig.3), is basically Fig.2 with the addition of a current limiting facility. This uses another transistor to sense the voltage across a resistor network in series with the output. The current limit rotary switch (SW2a) selects a combination of resistors, R14 to R18, for a voltage drop corresponding to the desired current limit. This voltage plus the Vbe of Q1, will eventually equal the combined conducting voltage of LED2 and Q2's Vbe. When Q2 begins conducting LED2 will illuminate, drawing current from the output of IC1. This will tend to pull down the voltage at the base of Q1, with its emitter and the power supply output following suit.

The LM741 has internal current limiting, which in this case will allow a maximum of 25mA to flow through LED2, ensuring a consistent brilliance and preventing its destruction. In this current limiting action the LM741 behaves somewhat like a constant current source, sharing its current between LED2 and the base of Q1.

A 6.8V zener diode (ZD1) is the voltage reference for a resistor ladder (R4 to R10), which supplies IC1 via the voltage selection switch SW1a. As the circuit has a gain of two, the reference voltage required will be half of the desired output voltage, therefore for the 9V position the reference is 4.5V.

When a reference for the 1.5V range is selected by SW1a, the same voltage as the 3V range is applied to IC1, but the gain of the circuit is dropped to one rather than two. This is achieved by

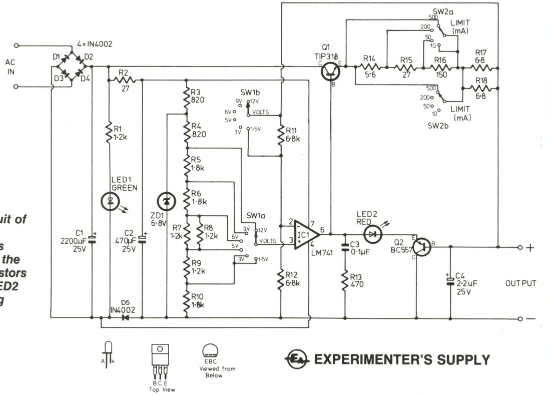
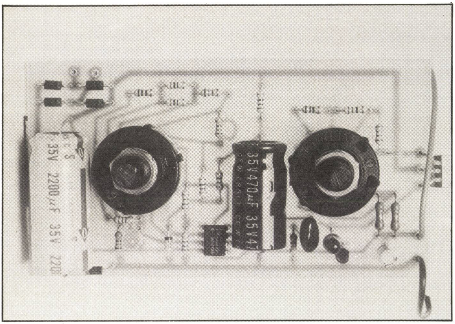


Fig.3 Complete circuit of the power supply. Transistor Q2 senses voltage drop across the current sensing resistors R14 to R18, while LED2 indicates the limiting action.



The completed circuit board. Note the mounting of Q1.

SW1b shorting out the feedback resistor R11 when the 1.5V setting is selected. A level of 0.75V was out of the linear region of the inputs of the LM741, and resulted in poor output regulation. Since SW1 was a double pole switch, utilising the second half was a simple solution to the above problem.

Similar advantage was taken of the current selector switch SW2b, used to boost the current capacity of SW2a on the 500mA range.

Diode D5 is included to effectively give the LM741 a slight negative supply rail of 0.7V, once again to keep it in its linear region.

Capacitor C3 and resistor R13 provide a high frequency load to the output of IC1 to ensure stability, and C4 removes any remaining ripple from the output.

The AC voltage from the plugpack feeds the bridge rectifier of D1 to D4 and the 2200uF filtering capacitor C1, whilst further filtering for the reference and IC1 is provided by R1 and C2. A green LED indicates a DC source voltage is present.

Construction

The prototype was assembled on a PCB (code 87ps9) measuring 62x122mm, which mounts directly by the switch shafts into a low cost aluminium box. The box has sufficient area to double as a heatsink for the series pass transistor Q1. This style of construction virtually eliminates any mounting hardware and wiring within the box, the circuit board simply having AC in and DC out connections. Once the components have been mounted on the board, it is then a simple matter to mount it in the box and be under way!

Start the construction by mounting all the smaller components on the PCB, following with the larger components such as the main capacitors, and finish with the rotary switches.

The switches used in this project are the sealed PCB mount rotary type, which have a removable ring under the locknut to set the number of positions. This ring has a tab that may be placed in a choice of slots labelled from 2 to 11, the 12th position being available with the ring removed. Therefore, S1 and S2 are set to the 6 and 4 positions respectively. The PCB holes for the switches will need to be quite large, because the large number of pins makes them a little tricky to install.

Construction of the rest of the unit is quite straightforward, the components fitted to the board as shown in the component overlay. Particular care must be taken with the polarity of the semiconductors and electrolytic capacitors. The resistors should be mounted a couple of millimetres off the board to allow enough airspace for cooling.

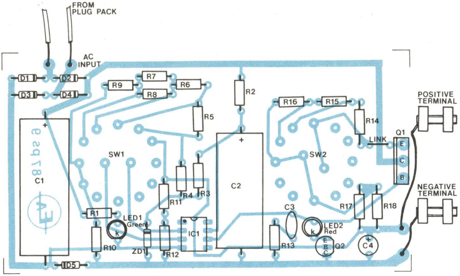
The TIP31 transistor is bolted to the box between the output terminals, a mica washer being used to insulate it from the chassis, and heatsink compound applied for a good thermal path. To reach this mounting position, the transistor legs were bent so that it hung below the PCB.

When the circuit board is completed, the height of the LEDs can adjusted to protrude the correct amount through the top of the box. Small lengths of wire (component leg offcuts) can be used if the LED legs are too short. Only the top section of the LED mounting clips are needed to provide a neat finish to the front panel.

The rest of the wiring is very simple. A couple of pieces of hookup wire link the PCB to the banana sockets, and the plug pack lead enters the box via a rubber grommet.

The negative output banana socket (black) may be electrically connected to the box (as in the prototype), or left disconnected if a "floating" case is desired. For experimental work the latter is often preferable.

The front panel artwork has been reproduced here, and can be used by those who wish to make their own. A Scotchcal panel was used on the prototype.



Component overlay. Q1 must have sufficient leg length for it to be bent over below the circuit board.

Testing

When all is completed, the unit can be tested with a multimeter (if available), for the correct output voltages. These voltages should be quite close to those specified, but are largely at the mercy of the resistor tolerances, which in this case is 5 percent.

The current ranges may be tested by simply shorting the output with a multimeter on the Amps range. The "limit" LED should illuminate to indicate the current limiting action, with current being limited to a value as set by S2. Care should be taken not to exceed the multimeter maximum current rating.

If a 12VAC plug pack of moderate current capacity (500mA or less) is used with this power supply, the 12V position may not yield the full 500mA current. This is due to the plug pack voltage dopping below its rated 12V at higher currents, consequently the circuitry has insufficient DC supply for good regulation. A 15VAC plug pack of at least 500mA capacity is recommended for maximum performance. EA

PARTS LIST

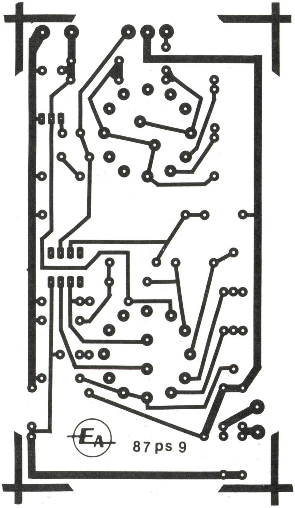
1 metal box, 133x76x54mm (or larger)
1 PCB, code 87ps9, 66x122mm
2 4mm binding posts, (1 red, 1 black)
1 2-pole 6 position PCB mount rotary switch
1 2-pole 4 position PCB mount rotary switch (see text)
2 Knobs for switches
1 Plug pack 12 or 15 VAC, 500mA or greater.

Semiconductors
5 1N4002 diodes
1 5mm red LED
1 5mm green LED
1 LM741 op-amp
1 TIP31 (B or C) transistor
1 BC557 transistor
1 6.8 volt 400mW zener diode

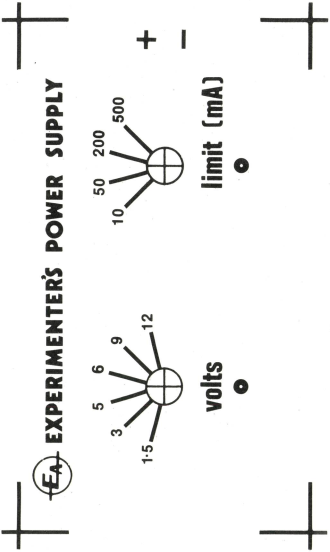
Capacitors
1 2200uF 25VW axial type electrolytic
1 470uF 25VW axial type electrolytic
1 2.2uF 25VW PCB mount electrolytic
1 0.1uF greencap

Resistors (all 0.5W 5%)
1 5.6Ω
2 6.8Ω
2 27Ω
1 150Ω
1 470Ω
2 820Ω
4 1.2kΩ
3 1.8kΩ
2 6.8kΩ

Miscellaneous
Mounting hardware for TIP31, Heatsink compound, 2 x LED mounting kits, hookup wire, solder, rubber grommet.



This full size artwork may be used to make your own PCB.



The actual size artwork for the front panel.

THE SMALL COMPUTER SYSTEM INTERFACE (SCSI) BUS

Pronounced "skuzzie", the SCSI bus is now an internationally accepted interface standard for connecting hard disk drives and other mass storage peripherals to microcomputer systems.

SCSI was developed from, and is an enhancement of, an interface bus developed by Shugart Associates for interfacing that company's hard disk and streaming tape drives. The original bus was called the SASI (Shugart Associates system interface).

Peripherals to be connected to the SCSI bus must have their own inbuilt intelligent controllers, which perform local control of all "primitive" device functions and only need to communicate with the main processor as a logical subsystem sending and receiving data blocks.

SCSI is a local area interface, designed to transfer data at up to 4 megabits per second over distances of up to 6m with unbalanced wiring, or up to 25m with balanced wiring techniques. Up to eight devices may be connected to the bus, including the computer (or computers).

The SCSI bus uses 50-way flat ribbon or twisted-wire cable, and ID (insulation displacement) type connectors having two rows of 25 pins with 0.1" spacing between both rows and pins (Fig.1).

All devices are connected to the bus in daisy-chain fashion, with all signals common to all devices and all signal lines actively terminated at each end (Fig.2).

Normally there is a single "Talker" or Initiator device, which initiates the data transactions on the bus. The rest of the devices are "Listeners" or Targets, which respond to commands from the Initiator. Usually the computer is the Initiator, and the peripheral devices are the Targets (Fig.3). However there can be multiple Initiators on the bus if the SCSI bus's arbitration option is implemented.

As shown in Fig.1 the SCSI interface provides eight parallel data lines DB(0-7) with a ninth (odd) parity bit DB(P). There are also nine status and control lines, and one power supply line for the active terminations. All other lines are earthed, except in balanced systems where all data and control lines have matching return lines.

Negative logic polarity is used throughout, with buslines driven by open collector or tristate driver outputs. Logic true or "1" corresponds to voltages from 0 to 0.4V, while logic false or "0" corresponds to voltages from 2.5 to 5.25V.

Information transfers on the SCSI bus are generally asynchronous, although synchronous transfer is an optional enhancement. Data is transferred byte by byte, with REQ/ACK handshaking. However an extended command set capability allows up to 65,535 data blocks to be transferred in response to a single command. The logical addressing capability is up to 32 bits, allowing data blocks of up to 2^{32} bytes in length.

Each of the up to eight devices connected to the SCSI bus is assigned a fixed identification or "address" code (0-7), designated directly by the bits of address bytes (Fig.4). The codes are predetermined in terms of arbitration priority for bus control; the device with code 7 has the highest priority, and that with code 0 the lowest.

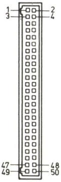
Typical SCSI bus data transfers consist of three main phases, the first two selected by the Initiator and the third by the designated Target.

First the Initiator looks for a 'bus free' condition, and then makes a bid to capture control of the bus. This is called the *arbitration* phase. If no device with higher priority bids, the Initiator gains bus control and enters the *selection* phase, flagging up the Target device with which it desires to communicate.

The third, or *information transfer* phase is entered when the selected Target device responds, and indicates the type of transfer it is prepared to engage in. These include Data In or Data Out, Command Request, Status acknowledge, Message In or Message Out.

Many mass storage devices and peripherals are now being provided with an inbuilt controller and SCSI interface. Similarly many small computers are being provided with either a built-in SCSI bus port, or can be provided with one via a so-called "host interface controller". These are now available as plug-in adapter cards, made for a variety of internal system bus standards.

- Jim Rowe



SIGNAL	PIN NUMBER
-DB (0)	2
-DB (1)	4
-DB (2)	6
-DB (3)	8
-DB (4)	10
-DB (5)	12
-DB (6)	14
-DB (7)	16
-DB (P)	18
GROUND	20
GROUND	22
GROUND	24
*TERMPWR	26
GROUND	28
GROUND	30
-ATN	32
GROUND	34
-BSY	36
-ACK	38
-RST	40
-MSG	42
-SKL	44
-C/D	46
-REQ	48
-I/O	50

Note: This pin is reserved for providing optional terminator power (plus 5 volts).

Note: All odd pins except pin 25 shall be connected to ground. Pin 25 should be left open but may be connected to ground.

The minus indicates active low.

Fig.1: SCSI interface connector and signals. The *Tempwr pin (26) provides the +5V for active bus terminations. All pins not identified are normally grounded, except pin 25. All signal pins use negative logic.

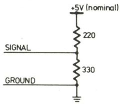


Fig.2: The active terminations used for all signal lines, in the typical unbalanced case.

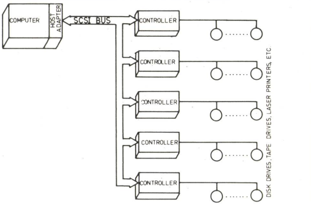


Fig.3: A typical SCSI bus configuration, with a single Initiator and multiple Target devices.

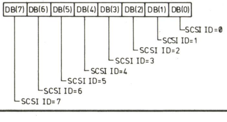
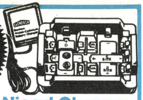


Fig.4: Each device on the SCSI bus is assigned a fixed address, which have a fixed order of bus priority.

Limited Stocks Priced to clear.



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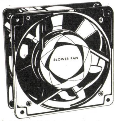

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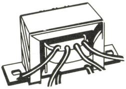

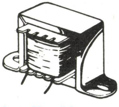

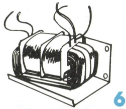

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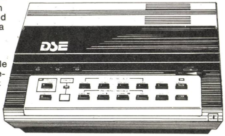

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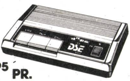

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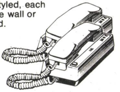

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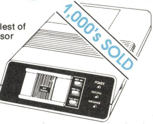

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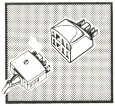

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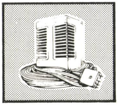

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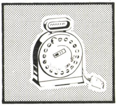

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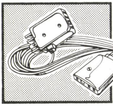

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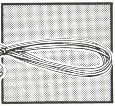

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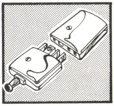

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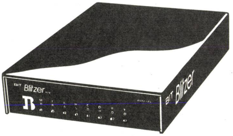

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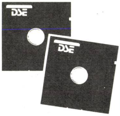

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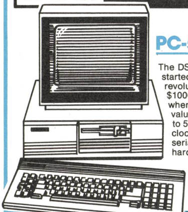

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Monitor extra: choose the type you require from our great Multitech range.

Budget Swivel Base

Nylon slide assembly and non-skid feet for positive action. Allows full 360° rotation and 25° vertical adjustment. Suits all monitors from 22cm to 35cm screen size.
Cat X-1190 **$24.95**

Deluxe Swivel Base

Similar to above, but has knurled knob on front for locking or freeing monitor, the monitor does not have to be removed to adjust angle.
Cat X-1191 **$34.95**

Serial Data Cable

2.3 metre serial cable with male DB25 plug one end, female DB25 socket to the other. All 25 pins wired 1-1, etc. For serial printers, modems, computer/computer connection, and other data applications. Or extension lead for parallel printer cable.
Cat X-3564 **$39**

Cleaning Fluid

Cleans and deodorises. Intended for use with wipes (see right), but also suits other wiping materials.
Cat X-3562 **$3.95**

Parallel Printer Cable

Standard "Centronics" type printer cable with 36 pin Centronics plug (as used on 99% parallel printers) one end, 25 pin D socket the other. 1.7m long. Cat X-8614 **$34.95**

Lint-Free Wipes

Generous 305 × 380mm wipes for screens, keyboards, etc plus other items around home/office. 10 wipes in pack.
Cat X-3563 **$5.50**

DICK SMITH ELECTRONICS COMPUTERSTOP

• NSW • Albury *21 8399* • Bankstown Square *707 4888* • Blacktown *671 7722* • Blakehurst *546 7744* • Bondi Junction *387 1444*• Brookvale (Warringah Mall) *93 0441* • Campbelltown *27 2199* • Chatswood Chase *411 1955* • Chullora *642 8922* • Gore Hill *439 5311* • Gosford *25 0235* • Hornsby *477 6633* • Liverpool *600 9888* • Maitland *33 7866* • Miranda *525 2722* • Newcastle *61 1896* • North Ryde *88 3855* • Parramatta *689 2188* • Penrith *32 3400* • Railway Square *211 3777* • Sydney City *267 9111* • Tamworth *66 1711* • Wollongong *28 3800* • ACT • Fyshwick *80 4944* • VIC • Ballarat *31 5433* • Bendigo *43 0388* • Box Hill *890 0699* • East Brighton *592 2366* • Coburg *383 4455* • Essendon *379 7444* • Frankston *783 9144* • Geelong *43 8804* • Melbourne City *670 9834* • Richmond *428 1614* • Ringwood *879 5338* • Springvale *547 0522* • QLD • Brisbane City *229 9377* • Buranda *391 6233* • Chermside *359 6255* • Redbank *288 5599* • Rockhampton *27 9644* • Southport *32 9863* • Toowoomba *38 4300* • Townsville *72 5722* • Underwood *341 0844* • SA • Adelaide City *232 1200* • Darlington *298 8977* • Elizabeth *255 6099* • Enfield *260 6088* • Salisbury *281 1593* • WA • Cannington *451 8666* • Fremantle *335 9733* • North Perth *328 6944* • Perth City *481 3261* • TAS • Hobart *31 0800* • NT • Stuart Park *81 1977*

Calling ALL 'Sparks'...

Where do you get all those plugs, leads, sockets, switches and things to get your home working? Why, your DSE store of course!! DSE for great value, great prices and a great range.

Now you can get it at DSE!!

3 Core Flat Light Cable

Need an extra light in the bathroom, laundry, workspace, etc? 3 core flat 1/113 light cable with insulated earth and rated at 10 amps (1.13mm) at super low prices!! And at DSE there's no need to buy huge volumes to get the best price. Cat W-2060

95¢ / metre

3 Core Power Cable

Save even more! 3 core flat 1/178 Power Cable with insulated earth at this fantastic low price. This stuff is usually referred to as builder's cable. Rated at 25 amps (2.5mm) you can have power wherever you need it! Cat W-2062

$1.50 / metre

Power Point Safety Tester

Check newly installed power points, old homes, etc. Just plug in and light pattern reveals any faults. Cat P-5300

$7.55

3 Pin Plug Side Entry

Standard 3 pin AC plug with cable entry on the side — ideal for using with awkward equipment. Cat P-5402

$2.25

3 Pin Piggy Back Plug

Standard 3-pin plug with 3 pin socket as well — doubles up one power point. Cat P-5405

$3.95

Line Socket

Ideal for making up extension cords — standard 3 pin AC socket. Cat P-5410

$3.95

Wall Board Clip

Can be mounted from the front. Mount power outlets, switch plates, on any cavity wall (other than brick) without the need for a mounting block. Cat P-5530

$1.30

Spotlight Holder

Edison screw holder to suit PAR38 and other ES bulbs. Can be adjusted over 30° for exact positioning. (Suits coloured bulbs). Cat P-5620

$6.25

Child-Proof Protector

Stop young children's prying fingers by placing these plastic safety plugs into the outlet when not in use. Cat P-5420

$2.95

Surface Socket

Standard 3 pin AC socket that can be screwed to boards or walls — Ideal for workshop use. Cat P-5415

$3.70

Blank Plate

Same size as power point, but blank: ideal for gap-filling when you move points, switches, etc. Cat P-5535

$2.25

Double Adaptor

Standard 3 pin AC plug into 2 AC sockets enabling you to use 2 appliances on one outlet. Cat P-5440

$3.40

3Pin IEC Line Plug

Female line socket. Standard IEC. Cat P-5580

$4.15

3 Pin IEC Chassis Socket

Male Chassis socket, as used with above plug. 3 pin vertical IEC pattern. Cat P-5585

$3.15

Light Socket

Light socket for bayonet mount lamps. Ideal replacement for light fittings. Comes in white plastic. Cat P-5510

$2.50

Line Switch

High impact plastic moulded switch for insertion in any cord for remote on/off. Ideal for putting on/off switch in a floor standing lamp. Cat P-5515

$6.25

Suppressor Plug

Standard 3 pin AC plug, with capacitors fitted to reduce unwanted pops and crackles from audio equipment. Cat P-5425

$7.35

Standard Mounting Box

Mount power points, plates, etc on any surface including brick. Cat P-5531

$2.25

Double Power Point

Replace old single outlets with a double; much more convenient.

Cat P-5560 **$11.80**

Architrave Switch

Standard architrave switch — can be used to replace old, worn out units in your home. Positive action switching. Cat P-5570

$4.95

Don't change Fuses

Forget about fumbling around in the dark! With these great Circuit Breakers you need never change a fuse again. They simply fit in the existing fuse holder.

Cat P-5910 10 Amp
Cat P-5915 15 Amp
Cat P-5920 16 Amp
Cat P-5925 20 Amp

ONLY $10.95

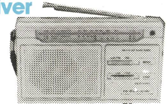
DICK SMITH ELECTRONICS

LISTEN HERE

10 Band portable!

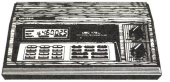
Bargain priced 10 Band portable from Sangean! AM/FM plus 8 shortwave bands to listen to. Has phones and DC sockets and comes with soft carry case! Cat D-2834 **$89**

Air Band Receiver



Listen to the air controllers and the pilots with this amazing value Air Band VHF & AM broadcast band. This compact device tunes to the entire band - so you won't miss a thing. Cat D-2836

EXCEPTIONAL VALUE! $29.95



Desk Top Scanner

Here's the best! From Uniden the Bearcat 175 XL gives you 16 channel, fully programmable scanning with more features than you could imagine. Auto search, direct channel access... it's got everything! Cat D-2812

$499

Uniden Hand-Held

You won't believe they could put so much in a hand held! The Bearcat 50XL has 10 channels, 10 bands with manual or auto select, track tuning and more! Fantastic quality, great price! Cat D-2814

$299

Helical Dipole Antenna

Superb Helical Dipole scanner antenna which covers all major bands - 70 to 174 and 400 to 500MHz. Just 155mm long it's easily mounted and comes fitted with 3.5m cable. Cat D-4432 **$39.95**

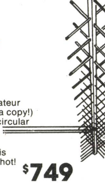
Mobile Scanner Antenna

Broadband antenna covering 65-520MHz! Just screw it to your antenna base! Cat D-4434

BARGAIN $11.95

NEW!

Professional Quality Amateur Satellite Antenna



Satracker SA270 is the ultimate antenna for amateur satellite work it's received rave reviews (ask for a copy!) Features remote switchable left and right hand circular polarisation, with 70cm uplink and 2m downlink (suitable for Oscar, Jamsat, Russians, etc.)

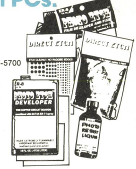
If you work satellites, you'll know every picovolt is precious: the Satracker will give you your best shot! Complete with coax harness and all mounting hardware. Cat D-4706 **$749**

MAGNAVOX

Check out these amazing value speakers from Magnavox! Ideal as replacement speakers or for that new system. Trust DSE to bring you superb quality at rock bottom prices.

Cat No.	Type	Size	Rating	Price
C-2050	Woofer	300mm	80 watts	$49.95
C-2052	Woofer	250mm	65 watts	$39.95
C-2054	Woofer	200mm	80 watts	$29.95
C-2062	Midrange	100mm	3 watts	$9.95
C-2070	Tweeter	80mm	30 watts	$9.95
C-2080	Twin Cone	200mm	20 watts	$19.95
C-2082	Twin Cone	200mm	55 watts	$24.95

New!! Build your own PCs.



With Photo Etch you can now make your own professional printed circuit boards from original art or a printed page. And there's no darkroom, camera, film cutting or tracing. Kit comes complete with everything you need including comprehensive instruction book! Cat N-5700

$104.95 Famous DATAK range. Made in USA.

Look at this!

N-5705	6 sheets of photocopy film 5″× 6″	**$18.85**
N-5709	2 sheets of photocopy film 8″× 11″	**$18.95**
N-5710	Profession contact printing frame for up to 9″× 12″ negs or positives.	**$35.65**
N-5711	Positive - Negative yellow filter	**$10.45**
N-5905	16 fluid ounces of negative resist developer.	**$11.00**
N-5750	Dry transfers. Switch and marks patterns.	**$11.95**
N-5766	Dry transfers. Large assorted pack.	**$19.95**
N-5820	Dry transfers. Assorted registers and targets.	**$7.95**
N-5715	Quality Burnishing Tool.	**$10.45**
N-5730	Tinnit bright tin plate powder. Makes 1 pint.	**$12.55**
N-5900	Circuit fix kit. Modify PCB's with pure copper tracks and donuts.	**$62.95**

Fold away Solar Calc.

Fits neatly in your pocket or purse. From Sharp the EL352 has all the standard functions including percentage and square root. Works on any light source! Cat V-3844 **$59.95**

Solar Metric Converter

Still having to convert to/from those dreaded Imperial measurements? The Sharp EL-344 solar powered converter makes it a breeze. Also acts as a standard calculator! Cat V-3845

$34.95

Plugs, sockets etc.

PLUG AND SOCKET BARGAIN BAZAAR!!

Stock up now at these great value prices!

Computer Connectors

P-2680	Printer Plug. 57-30360 suits most Centronics printers	**$9.50**
P-2681	As above printer socket. Centronics type.	**$12.30**
P-2678	36 way IDC flat ribbon Centronics type plug.	**$9.50.**
P-2693	25 pin IDC flat ribbon plug	**$10.45**
P-2694	25 pin IDC flat ribbon socket	**$9.95**
P-2750	34 way IDC flat ribbon socket	**$5.50**
P-2752	40 way IDC flat ribbon socket	**$6.50**
P-2754	50 way IDC flat ribbon socket	**$6.95**
P-2760	34 way Card Edge IDC connector	**$9.50**
P-2762	40 way Card Edge IDC connector	**$11.95**
P-2764	50 way Card Edge IDC connector	**$14.95**

Standard 'D' Type Connectors

P-2684	9 pin plug	**$2.75**
P-2685	9 pin socket	**$3.60**
P-2686	9 pin backshell	**$2.15**
P-2687	15 pin plug	**$3.25**
P-2688	15 pin socket	**$3.95**
P-2689	15 pin backshell	**$2.15**
P-2690	25 pin plug	**$2.95**
P-2691	25 pin socket	**$4.25**
P-2692	25 pin backshell	**$2.20**

IDS Flat Cable (peel off what you need)

W-2750	26 way flat cable	**$3.10/metre**
W-2752	34 way flat cable	**$3.85/metre**
W-2754	40 way flat cable	**$4.95/metre**
W-2756	50 way flat cable	**$5.75/metre**

Budget Scientific Calc.

Ideal for high school and Uni students. The Sharp EI-531A has 34 programmable functions, log, trig...all the most needed stuff! Cat V-3865

GREAT PRICE! $29.95

DICK SMITH ELECTRONICS
PTY LTD

NZ BARGAINS

LIMITED STOCKS

Sing along Tape Recorder

Save $20! Fantastic for the kids! Tape Recorder with Microphone lets you record or play back your favourite music and sing along at the same time. Don't pay more!
Cat A-4100

WAS $49.95 NOW $29.95

4.5 Digit LCD with 0.05% Accuracy

Professional quality multimeter that you'll be proud to own and readily depend on! Large LCD reads voltage/current, continuity (buzzer also), low battery warning and overrange indication with the 4 least significant digits blanked. Features gold plated PCB, 10M ohm input impedance on all AC/DC ranges.
Cat Q-1510

$195 WAS $295

AF Signal Generator

Square/Sine wave output audio signal generator, essential for work on huge range of circuits. With wide 20Hz-200kHz output and high accuracy, it is the perfect partner for the above RF generator.
Cat Q-1310

WAS $239 $179

Incredible value!

Our 1/4 Wave CB Helical has always been a popular choice amongst discerning CBers - now it's better value than ever! Only 1200mm long. Cat D-4413

WAS $56.50 $29.95

Whip up a bargain!

It's amazing! What incredible value for this Top Load Whip Antenna - it's ideal for truckies. Only 1700mm long with stainless steel tuning tips!
Cat D-4417

WAS $69.95 DISCOUNTED TO $39.95

Master Electronics

With the fantastic Blocktronics Deluxe Kit you can design and build your own circuits. Over 160 different configurations to build! Cat K- 2616

WAS $99 SAVE $30 $69

Blocktronic Empty

With these empty Blocktronics modules you can custom design your own circuits. Cat K-2618

$9.95

Less than 1/2 Price

Disk Doubler

Get up to double the capacity from those single sided disks with the great value Disk Notcher! Cat X-3505

$7.95 WAS $12.95 SAVE $5

9 Pin Plug & Socket

Save $4! Real bargain stuff! Cat P-1910

Bargain $1.50 Was $5.50

7 Core ELV Cable

7/0.2mm circular cable for low voltage applications. Cat W-2110

WAS $1.85 NOW 90¢

Aust. Amateur Call Book

It's like a telephone book for amateurs! Less than half price!! Cat B-2322

Was $24.50 Now $9.95

Single Sided Disks

Half Price!! Colourful and quality Single Sided Double Density Diskettes. Stock up while they're hot! Cat X-3507

JUST $1.99 WAS $3.99

TRANSFORMERS

High power 'C' Core

Primary: 240V AC
Secondary: 36-0-36V @ 2A
Cat M-0152

WAS $54.95 Incredible $19.95

6V Plug Pack

6V @ 450mA. Just like above only for 6 volt devices! Cat M-9559

Was $28.25 NOW $14.95

9V Plug Pack

9V @ 450mA. It's nearly half price! 450mA makes it suitable for most things around the house. Cat M-9561

Discount Price $14.95 WAS $28.25

Car Converter

Save $8 on this great Car Converter. Powers 9 volt devices from your car battery! Cat M-9585

WAS $17.95 Bargain $9.95

Semiconductor and Data Book

This has to be the best value information source you'll ever get! The DS Aust. Semiconductor & Application Book. Cat B-4200

Was $14.95 Amazing $2.50

Budget Communications

Ideal for the home or workshop! Three Station Intercom comes complete with wire, two slave units and master.
Cat F-1030

WAS $76.95 NOW ONLY $49.95

Listen to secret conversations

With the incredible Parabolic Ear you can listen to what's happening up to 6 metres away. Great fun!!
Cat J-7046

WAS $39.95 $24.50

Disk Bargains

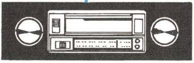
How's this? Quality DSE Double Sided Double Density Diskettes now are under $3!!! Stock up now! Cat X-3509

Was $4.95 Can't Miss at $2.99

2 Way PCB Terminal

Don't miss this - it's the hobbyist's dream. Quality 2-way PCB Terminals for less than half the price! Cat H-6744

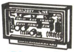
WAS $2.40 Down to 99¢



Car Stereo saver

Why not save a huge $70 off this Car AM/FM Radio Cassette? Top quality, unbelievable value!! Cat J-7048

SAVE $70 WAS $199 Fantastic $129



Alarming Discount!

Save an enormous $30 on our popular 2 Sector Alarm Module. Protect your property without spending a fortune! The bare bones system which doesn't cut corners on quality.
Cat L-5055

Down to WAS $79.95 $49.95

Alarm Ultrasonic

Fully self contained Ultrasonic Alarm at an alarming low price! Everything is built into this one. Cat L-5108

WAS $170 NOW $99

Discount Door Chime

Here's a bargain! Quality Door Chime with lead and instructions at this incredibly low price. Save $10!!
Cat Y-7000

SAVER $19.95

Suppressor Ignition Lead

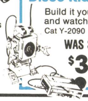
You can install these resistive suppressors (50K) anywhere in the HT lead to eliminate or reduce ignition noise.
Cat A-7904

WAS $2.40 95¢

Toys for young and old!

Save heaps on these great value toys! They're not only for the kids!

Disco Kid Robot Kit



Build it yourself and watch him jive!
Cat Y-2090

WAS $69.95 $39.95

Catchman II

Build your own mechanical 'Jeeves', he'll obey your every command.
Cat Y-2094

WAS $69.95 $39.95

6 Wheel Off-Roader

Watch it go anywhere! Climbs up to 45 degree slopes.
Cat Y-2512

SAVE $10 WAS $24.95 $14.95

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- Tauranga (075)87 071 • Wellington (04)73 9858

KITS KITS KITS

Flasher

Make it as the latest in electronic jewellery, or a burglar warning light, etc. The choice is yours and it's easy!
Cat K-2621 **$3.85**

Electronic Siren

Just what you need with the alarm! Also makes a great sound effects circuit — and FunWay 2 tells you what to do!
Cat K-2636 **$6.99**

120W Mosfet Amp Module

When its real power you want — such as PA, bandwork, even extra hi in your hi/fi — try this superb 120W module.
Cat K-3443
$109

Infrared R/C Repeater

Now you can use your infra-red remote control for your VCR, TV, Hi/Fi gear etc from any room in the house. Cat K-3426

$19.95

Radio Direction Finder

When coupled with a suitable FM receiver it rapidly indicates the direction of the RF signal being received. 32 LEDs represent the 32 points on the compass, indicate the direction of the received signal.
Cat K-6345 **$149**

HF Amateur Transceiver

It will give you any 500kHz segment between 2 and 30MHz — with commercial quality specs to boot! Everything is included — PLUS our special step-by-step instruction manual. Cat K-6330

$229

Teletext — without a VCR

Teletext Tuner

The Teletext Tuner can be built into your Teletext Decoder (Cat K-6315) so you don't need to own a VCR. Kit comes complete with everything you'll need including comprehensive, easy to follow instructions.
Cat K-6319 **$99.95**

IR Remote Control Preamp

Full comand over your hi-fi system without moving from your chair! The IR Remote Preamp comprises a complete preamp in which all functions can be selected by infra red remote control. And it's loaded with features!

Cat K-4003 **$259**

Solder on

Portable 12V Soldering Iron

Fitted with a 4.5 metre lead and clips to be attached to battery terminals, it can be powered from your car. Ideal for electrical work and is as easy to use as a pencil.
Cat T-1320

$26.95

Replacment tips

Cat T-1321 **$3.75**
Cat T-1322 **$3.75**

DSE Hobby Iron

A general purpose mains-powered iron for project building, service and repairs and other low-heat work. Iron element is rated at 15 watts so is ideal for the hobbyist — too much heat cooks the components!
Cat T-1310

$22.95

Varitemp Amp

Variable temperature — the right heat for every application! Interchangeable tips mean total flexibility. Cat T-1350

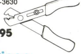
$35.95

Accessories to suit:

Spare Tip (medium) Cat Y- 1351 **$4.35**
Spare Tip (large) Cat Y-1352 **$4.35**
Spare Tip (conical) Cat Y- 1353 **$3.95**

Economy Wire Stripper

Large adjustable range. Hardened jaws will last a long, long time. Great value at around half the price of other makes.
Cat T-3630



$3.95

Deluxe Wire stripper

A completely automatic wire stripper. The multiple sized head allows a range of wire from 1mm to 3.2mm to be stripped. Ideal for servicemen, TV technicians, hobbyists etc.
Cat T-3620

$17.95

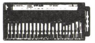
6 Piece Precision Set

The set consists of 4 blade drivers from 1.4mm to 2.9mm and 2 Phillips screwdrivers, No.0 and No.1. Cat T-4360 **$5.95**

21piece Tool Kit

WHAT AN ASSORTMENT
21 individual pieces in a handy plastic pack:
- 5 open ended spanners 4.0-6.0mm
- 2 Phillips head screwdrivers
- 3 Allen key drivers
- 5 nut drivers 3.0-5.0mm
- 5 flat screwdrivers
- 1 tommy bar

Cat T-4830 **$14.95**



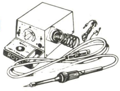
Hot Melt Glue Gun

Want to bond virtually anything to anything? You need a hot melt glue gun! It operates from mains power. Pistol shape design for ease of use, comes complete with mini stand. Interchangeable tips Cat T-4840
$19.95

Retractable Blade Neon Tester

Famous German "Boker" quality driver has retractable blade for safety PLUS inbuilt mains voltage neon tester (100 to 500V). Screwdriver blade length 25mm, 3mm width. Handle 115mm × 15mm diam.
Cat T-4007
$5.95

Royel Professional Soldering Station



Tips to suit:
Fine Cat T-2051
Standard Cat T-2053
Large (Bevelled) Cat T-2054 **$5.95EA.**

When quality really counts you need the best you can get. Royel is it: temperature sensing is dime right at the tip for instant reaction — and the zero voltage switching regultor means no interference and perfect control, Cat T-2050
$189

50mm Solder Rolls

200g bulk 60/40 resin cored solder rolls at bargain prices! Ideal for lab, workshop, production line...anywhere!

Cat N-1623 0.71mm
Cat N-1619 1.25mm (22g)

$7.95 EACH

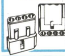
Complies to AS 1824 Australian Standard

Super Glue

No clamping, no mixing, no mess, sets in seconds. Has thousands of applications. 3ml Tube.
Cat N-1220 **$2.95**

SAVE 25%

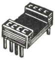
Utilux Molex Connectors



2 pin Plug & Socket	P-5102	**$1.20**
3 pin Plug & Socket	P-5103	**$1.45**
4 pin Plug & Socket	P-5105	**$1.65**
6 pin Plug & Socket	P-5106	**$1.55**
12 pin Plug & Socket	P-5103	**$2.55**

IC Sockets & Plugs

Why endanger valuable IC's by soldering them directly into circuit? Take the safe approach: use an IC socket! It makes service and repair of your project much, much easier too. There's an IC socket to suit almost all common ICs.



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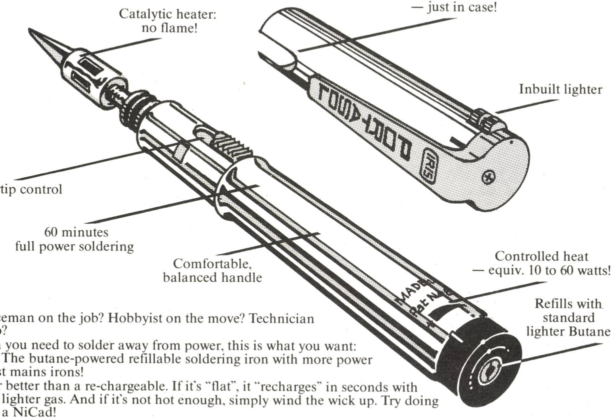
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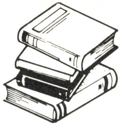
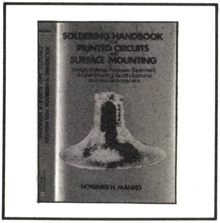



SOLDERING HANDBOOK FOR PRINTED CIRCUITS AND SURFACE MOUNTING
HOWARD H. MANKO

Manual on soldering

SOLDERING HANDBOOK FOR PRINTED CIRCUITS AND SURFACE MOUNTING, by Howard H. Manko. Van Nostrand-Reinhold Inc., 1986. Hard covers, 235 x 160mm, 430 pages. ISBN 0 442 26423 2.

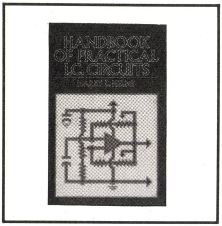
Gone are the days when electronic equipment was put together by rows of people at benches wielding smoking soldering irons (and breathing in lungfuls of resin vapour with lead flavouring). Nowadays it's PC boards, pick and place machines, wave soldering machines and surface mount technology — and in many ways that's a big improvement. There's not nearly as many dry joints, for a start; and hopefully less lung cancer than otherwise, too.

But as a result of these changes, soldering has itself become so much more than a superficial and matter of fact subject. (It never really was that, of course, but many people used to think it was nothing more than that.) Now it's a technology in itself, and one can spend a career specialising in its complexities.

The author of this book has done just that, starting as metallurgist with IBM and moving through positions with a solder and flux supply firm to eventually become a consultant and recognised authority on the subject. In this book he provides almost a distillation of the knowledge he has acquired during his 30-year career. There's a wealth of information on almost every conceivable aspect of soldering, which I've never seen brought together before. It's up to date, too — with lots of discussion on SMD technology and modern device packaging such as LCCs, PLCCs and pin-grid arrays, and techniques such as vapour-phase reflow soldering, etc.

In short, it's without a doubt the most comprehensive book on modern soldering technology that I've ever seen. It's also very well written and presented. If you're after a really good book on the subject, this is the one.

The review copy came from Van Nostrand Reinhold, but copies should be available from all major bookstores. (J.R.)



IC circuit cookbook

HANDBOOK OF PRACTICAL IC CIRCUITS, by Harry L. Helms. Prentice-Hall Inc, 1987. Hard covers, 236 x 159mm, 163 pages. ISBN 0 13 380833 5. Recommended retail price $85.50.

Those who've been around in electronics a while will have heard of Harry (Larry) Helms, who has been writing books and magazine articles in the USA for as long as I can remember. As he says in his preface to this latest book, he grew up like me in the days of vacuum tubes, and has found it very exciting following the developments from tubes through transistors to ICs.

In this book he provides a down-to-earth "cookbook" of practical and proven circuits, using readily available ICs. The emphasis is on circuit configurations that can be plugged into a design, without having to design them all over again from scratch. There's also introductory material covering how ICs are made, how they work and how they developed, and basic techniques for breadboarding and developing circuits.

Both analog and digital ICs and circuits are covered, from basic op-amp configurations through voltage regulators and phase-locked loops to TTL and CMOS logic circuits. Chips covered include the 741, the 555, the LM380, the 1458, the LM339, the XR2206, the LM3909 and numerous digital devices from the 7400 and 4000 series logic chips. At the end there's a handy chapter on "tying it all together", covering interfacing different device families, debugging and troubleshooting, and use of data sheets.

As you'd expect from Harry Helms, the text is clearly written and easy t follow. My only gripe is that the pric of the book seems pretty steep considering its modest size.

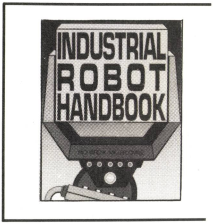
The review copy came from Prentice Hall of Australia, who advise that it' available from all major book stores. (J.R.)

All about robots

INDUSTRIAL ROBOT HANDBOOK by Richard K. Miller. Fairmont Pres Prentice-Hall, 1987. Soft covers, 279 212mm, 686 pages. ISBN 0 88173 023 0 13 463183 8. Recommended reta price $217.95.

No, I haven't made a mistake wit the price, that's the price quoted by th distributors! It must be about the mo expensive paperback I've ever seen – but then again, it's probably the bigge paperback I've ever seen. It also pr vides a lot of up-to-date information o the current state of the art in industri robotics, information that is no doul valuable to many production enginee

Continued on page 1



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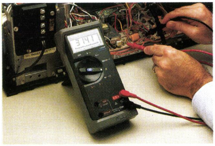

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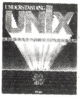

UNDERSTANDING UNIX

-James R. Groff, Paul N. Weinberg

The exploding popularity of the UNIX operating system is one of the most important trends in computing in the 1980's. UNIX is available on hundreds of different computers, ranging from personal computers to mainframes and supercomputers. *Understanding UNIX* offers an overall perspective on UNIX, including a discussion of where UNIX fits in the worlds of computing, business, and education. Individual chapters address the UNIX structure, file system, multiuser capability, specific applications tools, and more.

"A book that balances scope with depth; comprehensiveness with brevity." -Alan Kaplan

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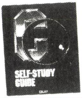

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-Jack Purdum

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-Bruce Brigham

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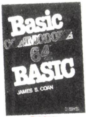

BASIC COMMODORE 64 BASIC

-James S. Coan

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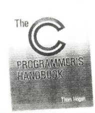

THE C PROGRAMMER'S HANDBOOK

-Thom Hogan

While other books will tell you how to learn C, this one shows you how to use it. It's a literal encyclopedia of the information you'll need to get it to work for you, efficiently and effectively. Handy and well organized, it gives you quick access to the things you need, when you need them, plus a clear definition of C language with examples and explanations of restrictions and defaults. You won't find an approach this understandable and objective anywhere else.

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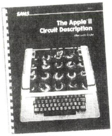

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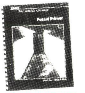

PASCAL PRIMER

-Mitchell Waite, David Fox

If you are learning programming or have dabbled in the popular language BASIC and wish to learn the capabilities of Pascal, this book is definitely written for you. Written and illustrated with a touch of humour, the informative text describes Pascal program structure, Pascal variables, Pascal procedures, and many other features. There are chapters on decision making statements, numeric functions, string functions, arrays and sets, and much more. The eight appendices present facts about the advantages and disadvantages of Pascal, components of a Pascal system, interfacing assembly language routines, and other useful information.

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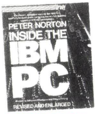

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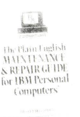

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-Pam Kelly-Hartley, Joy M^{c}Kneil, Tony Melius

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-Gil M. Schechter

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-Mark Greenshields

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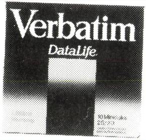

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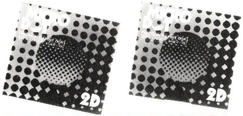

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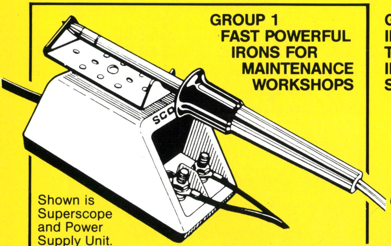

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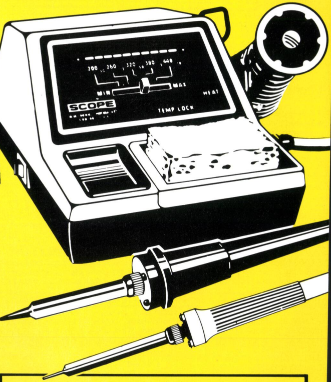

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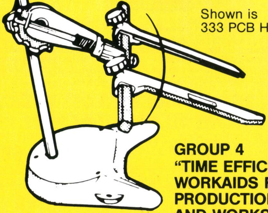

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Thermocouples without tears — 1

Most electronics people know very little about thermocouples, although they're still the simplest and most practical way to measure temperatures above about 150°C. Here's the first of two articles explaining how thermocouples work, the types that are available, and how you can put them to use.

by JIM ROWE

A few months ago I began working on a small hobby project that involved turning and milling some metal parts. The job called for a couple of special cutters, and the only feasible way to get these was to make them myself. This involved turning and milling them from "silver steel" (a high carbon steel with manganese and chromium added), followed by quench hardening and annealing.

For quench hardening, silver steel must be heated up to a temperature of about 780°C, held at this temperature for a short time, and then dropped into water (or brine, or oil) to cool it down suddenly. This causes the formation of a highly stressed crystal structure called Martensite, which is extremely hard.

The temperature the steel is heated to before quenching is fairly critical. If it's too low or too high, the steel won't harden properly. The traditional way for hobbyists to gauge the temperature is to go by its colour: 780°C is midway between "blood red" and "cherry red", for example.

Frankly, when I tried doing this, I got very mixed results indeed. One cutter turned out fine, but another didn't harden properly at all and I had to make a new one all over again. The problem seems to be that it's *very* hard to accurately judge the right colour for 780°C, even when you have a printed colour chart as a guide.

The obvious solution was to find a way to measure the temperature more accurately. Ah, I thought, what about thermocouples? They're supposed to be just the shot for measuring high temperatures. Surely EA had discussed how they work and how to use them, at some stage in the past . . .

It was then that I discovered the sad truth. We only seem to have talked about them and described a project using them once, in October 1984. And that was a project using an iron-constantan thermocouple, designed to measure temperatures only up to about 400°C. So for measuring up to around 800°C, I was on my own.

There was nothing for it but to search out the information myself, ringing up people who design them, make them or sell them, and picking their brains. Funny how one job can lead to another!

Actually the more I found out about thermocouples, the more interesting it became. So much so that before long, I realised the logical thing would be to turn what I'd learned into a couple of articles, to make it available to readers. I hope you find it all as interesting as I have, and can put it to practical use.

Right then, to begin. The principle of the thermocouple is quite old. It was discovered way back in 1821 by the

INTERNATIONAL CODE	METALS USED	TEMPERATURE RANGE	COMMENTS
S	Rhodium (+) vs Platinum 10%	0 — 1400°C	Very stable, but expensive
R	Rhodium (+) vs Platinum 13%	0 — 1400°C	Similar to type S
J	Iron (+) vs Copper-Nickel (Constantan)	0 — 800°C	Iron rusts if not protected
K	Nickel-Chromium ("Chromel") (+) vs Nickel-Aluminium ("Alumel")	0 — 1100°C	Suitable for oxidising atmospheres
T	Copper (+) vs Copper-Nickel (Constantan)	—200 — 400°C	Generally used for low and sub-zero temperatures
E	Nickel-Chromium ("Chromel") (+) vs Copper-Nickel (Constantan)	0 — 800°C	Accurate and stable, low cost
N	Nickel-Chromium-Silicon ("Nicrosil") (+) vs Nickel-Silicon ("Nisil")	0 — 1250°C	Very stable at high temperatures

TABLE 1: The main kinds of thermocouple in use

German physicist Thomas Johann Seebeck, who found that a small electric current was generated in a circuit formed from two different metals, provided that one of the two junctions between the metals was raised to a higher temperature than the other junction.

It turned out that the current was produced by an electromotive force, since dubbed the Seebeck EMF, whose voltage is roughly proportional to the temperature difference between the two junctions.

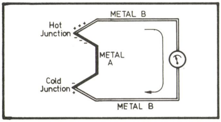

Fig.1: In its most basic form, a thermocouple consists of a circuit made from two metals. When one junction is made hotter than the other, a current flows.

The basic idea is shown in Fig.1. In reality there are two different Seebeck voltages generated, one at each junction and with opposing polarities, with the voltage produced by the hotter junction greater than that produced by the cold junction. The resultant voltage is therefore the difference between the two.

By the way, we're talking about quite small voltages here — typically only a few tens of millivolts. The actual voltage level depends on the two metals used to make the junctions. A number of different metal combinations have been used over the years, for thermocouples designed for different applications. The main types used are shown in Table 1. Each combination of metals gives a different relationship between temperature and Seebeck output voltage, and has features which make it suitable for different kinds of use.

Note especially the type N thermocouple, which is the most recent type to be developed and largely supersedes many of the earlier types. It uses Nickel-Chromium-Silicon alloy ("Nicrosil") and Nickel-Silicon-Magnesium alloy ("Nisil"), which give excellent temperature stability and long working life at temperatures up to about 1230°C. It also has considerably higher output than the precious metal types S and R, and is also much lower in cost.

The type N thermocouple became an international standard type in 1984, after its development by Australian scientist Dr Noel Burley.

EMF in Absolute Millivolts — **Reference Junctions at 0 C**

THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS

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0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397	0
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798	10
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.162	1.203	20
30	1.203	1.244	1.285	1.325	1.366	1.407	1.448	1.489	1.529	1.570	1.611	30
40	1.611	1.652	1.693	1.734	1.776	1.817	1.858	1.899	1.940	1.981	2.022	40
50	2.022	2.064	2.105	2.146	2.188	2.229	2.270	2.312	2.353	2.394	2.436	50
60	2.436	2.477	2.519	2.560	2.601	2.643	2.684	2.726	2.767	2.809	2.850	60
70	2.850	2.892	2.933	2.975	3.016	3.058	3.100	3.141	3.183	3.224	3.266	70
80	3.266	3.307	3.349	3.390	3.432	3.473	3.515	3.566	3.598	3.639	3.681	80
90	3.681	3.722	3.764	3.805	3.847	3.888	3.930	3.971	4.012	4.054	4.095	90
100	4.095	4.137	4.178	4.219	4.261	4.302	4.343	4.384	4.426	4.467	4.508	100
110	4.508	4.549	4.590	4.632	4.673	4.714	4.755	4.796	4.837	4.878	4.919	110
120	4.919	4.960	5.001	5.042	5.083	5.124	5.164	5.205	5.246	5.287	5.327	120
130	5.327	5.368	5.409	5.450	5.490	5.531	5.571	5.612	5.652	5.693	5.733	130
140	5.733	5.774	5.814	5.855	5.895	5.936	5.976	6.016	6.057	6.097	6.137	140
150	6.137	6.177	6.218	6.258	6.298	6.338	6.378	6.419	6.459	6.499	6.539	150
160	6.539	6.579	6.619	6.659	6.699	6.739	6.779	6.819	6.859	6.899	6.939	160
170	6.939	6.979	7.019	7.059	7.099	7.139	7.179	7.219	7.259	7.299	7.338	170
180	7.338	7.378	7.418	7.458	7.498	7.538	7.578	7.618	7.658	7.697	7.737	180
190	7.737	7.777	7.817	7.857	7.897	7.937	7.977	8.017	8.057	8.097	8.137	190
200	8.137	8.177	8.216	8.256	8.296	8.336	8.376	8.416	8.456	8.497	8.537	200
210	8.537	8.577	8.617	8.657	8.697	8.737	8.777	8.817	8.857	8.898	8.938	210
220	8.938	8.978	9.018	9.058	9.099	9.139	9.179	9.220	9.260	9.300	9.341	220
230	9.341	9.381	9.421	9.462	9.502	9.543	9.583	9.624	9.664	9.705	9.745	230
240	9.745	9.786	9.826	9.867	9.907	9.948	9.989	10.029	10.070	10.111	10.151	240
250	10.151	10.192	10.233	10.274	10.315	10.355	10.396	10.437	10.478	10.519	10.560	250
260	10.560	10.600	10.641	10.682	10.723	10.764	10.805	10.846	10.887	10.928	10.969	260
270	10.969	11.010	11.051	11.093	11.134	11.175	11.216	11.257	11.298	11.339	11.381	270
280	11.381	11.422	11.463	11.504	11.546	11.587	11.628	11.669	11.711	11.752	11.793	280
290	11.793	11.835	11.876	11.918	11.959	12.000	12.042	12.083	12.125	12.166	12.207	290
300	12.207	12.249	12.290	12.332	12.373	12.415	12.456	12.498	12.539	12.581	12.623	300
310	12.623	12.664	12.706	12.747	12.789	12.831	12.872	12.914	12.955	12.997	13.039	310
320	13.039	13.080	13.122	13.164	13.205	13.247	13.289	13.331	13.372	13.414	13.456	320
330	13.456	13.497	13.539	13.581	13.623	13.665	13.706	13.748	13.790	13.832	13.874	330
340	13.874	13.915	13.957	13.999	14.041	14.083	14.125	14.167	14.208	14.250	14.292	340
350	14.292	14.334	14.376	14.418	14.460	14.502	14.544	14.586	14.628	14.670	14.712	350
360	14.712	14.754	14.796	14.838	14.880	14.922	14.964	15.006	15.048	15.090	15.132	360
370	15.132	15.174	15.216	15.258	15.300	15.342	15.384	15.426	15.468	15.510	15.552	370
380	15.552	15.594	15.636	15.679	15.721	15.763	15.805	15.847	15.889	15.931	15.974	380
390	15.974	16.016	16.058	16.100	16.142	16.184	16.227	16.269	16.311	16.353	16.395	390
400	16.395	16.438	16.480	16.522	16.564	16.607	16.649	16.691	16.733	16.776	16.818	400
410	16.818	16.860	16.902	16.945	16.987	17.029	17.072	17.114	17.156	17.199	17.241	410
420	17.241	17.283	17.326	17.368	17.410	17.453	17.495	17.537	17.580	17.622	17.664	420
430	17.664	17.707	17.749	17.792	17.834	17.876	17.919	17.961	18.004	18.046	18.088	430
440	18.088	18.131	18.173	18.216	18.258	18.301	18.343	18.385	18.428	18.470	18.513	440
450	18.513	18.555	18.598	18.640	18.683	18.725	18.768	18.810	18.853	18.895	18.938	450
460	18.938	18.980	19.023	19.065	19.108	19.150	19.193	19.235	19.278	19.320	19.363	460
470	19.363	19.405	19.448	19.490	19.533	19.576	19.618	19.661	19.703	19.746	19.788	470
480	19.788	19.831	19.873	19.916	19.959	20.001	20.044	20.086	20.129	20.172	20.214	480
490	20.214	20.257	20.299	20.342	20.385	20.427	20.470	20.512	20.555	20.598	20.640	490
500	20.640	20.683	20.725	20.768	20.811	20.853	20.896	20.938	20.981	21.024	21.066	500
510	21.066	21.109	21.152	21.194	21.237	21.280	21.322	21.365	21.407	21.450	21.493	510
520	21.493	21.535	21.578	21.621	21.663	21.706	21.749	21.791	21.834	21.876	21.919	520
530	21.919	21.962	22.004	22.047	22.090	22.132	22.175	22.218	22.260	22.303	22.346	530
540	22.346	22.388	22.431	22.473	22.516	22.559	22.601	22.644	22.687	22.729	22.772	540
550	22.772	22.815	22.857	22.900	22.942	22.985	23.028	23.070	23.113	23.156	23.198	550
560	23.198	23.241	23.284	23.326	23.369	23.411	23.454	23.497	23.539	23.582	23.624	560
570	23.624	23.667	23.710	23.752	23.795	23.837	23.880	23.923	23.965	24.008	24.050	570
580	24.050	24.093	24.136	24.178	24.221	24.263	24.306	24.348	24.391	24.434	24.476	580
590	24.476	24.519	24.561	24.604	24.646	24.689	24.731	24.774	24.817	24.859	24.902	590
600	24.902	24.944	24.987	25.029	25.072	25.114	25.157	25.199	25.242	25.284	25.327	600
610	25.327	25.369	25.412	25.454	25.497	25.539	25.582	25.624	25.666	25.709	25.751	610
620	25.751	25.794	25.836	25.879	25.921	25.964	26.006	26.048	26.091	26.133	26.176	620
630	26.176	26.218	26.260	26.303	26.345	26.387	26.430	26.472	26.515	26.557	26.599	630
640	26.599	26.642	26.684	26.726	26.769	26.811	26.853	26.896	26.938	26.980	27.022	640
650	27.022	27.065	27.107	27.149	27.192	27.234	27.276	27.318	27.361	27.403	27.445	650
660	27.445	27.487	27.529	27.572	27.614	27.656	27.698	27.740	27.783	27.825	27.867	660
670	27.867	27.909	27.951	27.993	28.035	28.078	28.120	28.162	28.204	28.246	28.288	670
680	28.288	28.330	28.372	28.414	28.456	28.498	28.540	28.583	28.625	28.667	28.709	680
690	28.709	28.751	28.793	28.835	28.877	28.919	28.961	29.002	29.044	29.086	29.128	690
700	29.128	29.170	29.212	29.254	29.296	29.338	29.380	29.422	29.464	29.505	29.547	700
710	29.547	29.589	29.631	29.673	29.715	29.756	29.798	29.840	29.882	29.924	29.965	710
720	29.965	30.007	30.049	30.091	30.132	30.174	30.216	30.257	30.299	30.341	30.383	720
730	30.383	30.424	30.466	30.508	30.549	30.591	30.632	30.674	30.716	30.757	30.799	730
740	30.799	30.840	30.882	30.924	30.965	31.007	31.048	31.090	31.131	31.173	31.214	740
750	31.214	31.256	31.297	31.339	31.380	31.422	31.463	31.504	31.546	31.587	31.629	750
760	31.629	31.670	31.712	31.753	31.794	31.836	31.877	31.918	31.960	32.001	32.042	760
770	32.042	32.084	32.125	32.166	32.207	32.249	32.290	32.331	32.372	32.414	32.455	770
780	32.455	32.496	32.537	32.578	32.619	32.661	32.702	32.743	32.784	32.825	32.866	780
790	32.866	32.907	32.948	32.990	33.031	33.072	33.113	33.154	33.195	33.236	33.277	790
800	33.277	33.318	33.359	33.400	33.441	33.482	33.523	33.564	33.604	33.645	33.686	800
810	33.686	33.727	33.768	33.809	33.850	33.891	33.931	33.972	34.013	34.054	34.095	810
820	34.095	34.136	34.176	34.217	34.258	34.299	34.339	34.380	34.421	34.461	34.502	820
830	34.502	34.543	34.583	34.624	34.665	34.705	34.746	34.787	34.827	34.868	34.909	830
840	34.909	34.949	34.990	35.030	35.071	35.111	35.152	35.192	35.233	35.273	35.314	840
850	35.314	35.354	35.395	35.435	35.476	35.516	35.557	35.597	35.637	35.678	35.718	850
860	35.718	35.758	35.799	35.839	35.880	35.920	35.960	36.000	36.041	36.081	36.121	860
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.483	36.524	870
880	36.524	36.564	36.604	36.644	36.684	36.724	36.764	36.804	36.844	36.885	36.925	880
890	36.925	36.965	37.005	37.045	37.085	37.125	37.165	37.205	37.245	37.285	37.325	890
900	37.325	37.365	37.405	37.445	37.484	37.524	37.564	37.604	37.644	37.684	37.724	900
910	37.724	37.764	37.803	37.843	37.883	37.923	37.963	38.002	38.042	38.082	38.122	910
920	38.122	38.162	38.201	38.241	38.281	38.320	38.360	38.400	38.439	38.479	38.519	920
930	38.519	38.558	38.598	38.638	38.677	38.717	38.756	38.796	38.836	38.875	38.915	930
940	38.915	38.954	38.994	39.033	39.073	39.112	39.152	39.191	39.231	39.270	39.310	940
950	39.310	39.349	39.388	39.428	39.467	39.507	39.546	39.585	39.625	39.664	39.703	950
960	39.703	39.743	39.782	39.821	39.861	39.900	39.939	39.979	40.018	40.057	40.096	960
970	40.096	40.136	40.175	40.214	40.253	40.292	40.332	40.371	40.410	40.449	40.488	970
980	40.488	40.527	40.566	40.605	40.645	40.684	40.723	40.762	40.801	40.840	40.879	980
990	40.879	40.918	40.957	40.996	41.035	41.074	41.113	41.152	41.191	41.230	41.269	990

TABLE 2: Seebeck Voltage vs Temperature (°C) for a type K Thermocouple (Chromel/Alumel)

The relationship between the temperature differential of the two junctions of a thermocouple and the resulting output voltage is not linear. In fact it's close to a parabolic curve. This tends to complicate matters a little, as we'll see shortly.

To make it easier to use thermocouples made from each combination of metals, the manufacturers provide calibration tables showing the Seebeck output voltage against junction temperature. Table 2 shows the calibration table for a type K thermocouple, which is one using Nickel-Chromium alloy ("Chromel") and Nickel-Aluminium alloy ("Alumel") as the two metals.

To use a thermocouple for measuring temperature, one of the two junctions is arranged to be held at a known "reference" temperature while the other junction is used as the measuring or "active" junction. The differential Seebeck voltage produced (Vm) is then measured.

For really accurate measurements, the reference junction should be held at an accurately controlled temperature, say by placing it in a container of melting ice (0°C). However for many purposes it is sufficient to have the reference junction at room temperature, provided that this can be measured fairly accurately using a normal thermometer.

Now if the relationship between temperature and Seebeck voltage were linear, we could work out the true temperature of the active junction by looking up the temperature difference corresponding to Vm, and then simply add the temperature of the reference junction to this. However because the relationship is parabolic rather than linear, this method is not accurate (see Fig.2). So instead we have to use:

Va = Vm + Vr

where Va is the Seebeck voltage which corresponds to the true temperature of the active junction, Vm is the measured differential voltage Vm, and Vr is the reference junction Seebeck voltage — looked up from the table after measuring the temperature of the reference junction using a thermometer.

In other words, we have to measure Vm, and add this to the reference junction voltage Vr looked up from the table. This gives the Va actually being produced by the active junction. Then we go back to the table with Va, to find the actual temperature Ta of the active junction.

There's another small complication. In practice, it's not really feasible to have the thermocouple measurement circuit wired entirely using the two metals used in the thermocouple itself. So the reference junction tends to get "split in two" by the external circuit — see Fig.3. The two resulting halves of the junction are where each of the two active junction metals are joined to the external wiring (Jr1 and Jr2). This causes no problems, provided that the two reference half-junctions are held at the same temperature, and the leads used to connect them to the external circuit are made from the same metal.

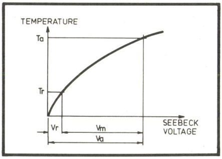

***Fig.2:** The relationship between temperature and the Seebeck voltage generated is not linear, but parabolic. This causes a few complications, as explained in the text.*

Over the years, thermocouples have been used for various things — mainly for measuring high temperatures, but not exclusively. Fig.4 shows a small non-inductive resistor/thermocouple combination housed in a glass vacuum envelope, and used for measuring the power produced by RF oscillators. The power is fed into the resistor, whose temperature naturally rises proportional to the RMS power level. The thermocouple output can thus be calibrated in terms of RF power level, knowing its Seebeck voltage characteristic. This kind of RF power measurement technique can be quite accurate and was fairly widely used before other methods were developed.

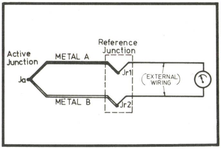

***Fig.3:** In practice, the reference junction is split into two half junctions Jr1 and Jr2, where the thermoelectric metals are joined to the external circuit.*

Practical thermocouples for measuring high temperatures directly tend to take a variety of forms. In the simplest case, they may be little more than a thin wire of each metal, fed through beads of ceramic insulator and spot-welded together to form the active junction (Fig.5). This kind of thermocouple can be used to measure the temperature in a small pottery kiln, for example.

For measurements in very corrosive or reactive environments, such as chemical vapours, molten metals or flames, it becomes necessary to encase the basic thermocouple with a protective sheath. As this must generally be made of metal, the thermocouple wires themselves must be encased in an insulating material inside the sheath.

There are three normal ways of doing this, shown in Fig.6. The first method (a) leaves the active junction itself exposed, in order to get a fast response time for measurements. However this cannot be used in highly corrosive or reactive environments.

The second method (b) encases the junction itself in insulation and sheath, as well as the leads. This gives good protection, but slows down the response to temperature changes because of the thermal resistance of the sheath and (more importantly) the insulation.

This shortcoming is overcome in the third method (c), where the junction is bonded to the inside of the sheath. This gives fast response, along with full protection.

A small low-cost type K thermocouple with a stainless steel sheath is shown in Fig.7. This measures 4mm in diameter and is 150mm long, with leads 520mm long. Designed for measurements to about 900°C, it was made by local firm Richard Foot of 26-30 Tepko Road, Terrey Hills, NSW 2084.

Typically and until very recently the

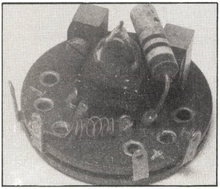

***Fig.4:** A small vacuum-enclosed thermocouple and load resistor combination, of the type used to measure RF power.*

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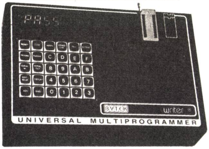

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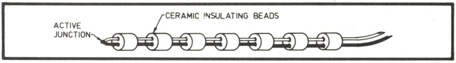


Fig.5: Basic construction of a simple thermocouple suitable for measuring temperature in an electric oven or furnace.

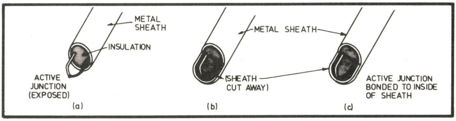

METAL SHEATH
INSULATION
ACTIVE JUNCTION (EXPOSED)
(a)
METAL SHEATH
(SHEATH CUT AWAY)
(b)
ACTIVE JUNCTION BONDED TO INSIDE OF SHEATH
(c)

Fig.6: The three traditional ways of protecting a thermocouple in highly corrosive or reactive environments. Method (a) leaves the junction itself exposed, while (b) and (c) include it inside the sheath.

sheath was made from stainless steel, inconel or ceramic materials. However more recently, special alloys like Nicrosil (Nickel-Chromium-Silicon) have been used. These offer distinct advantages in terms of matching the temperature expansion coefficient of the actual thermocouple metals, and minimising thermal stresses. Australian scientist Dr Noel Burley has again pioneered in this area, and has just announced the development of an improved sheath alloy called Nicrobell.

Dr Burley is general manager of R&D at Bell-IRH, of 32 Parramatta Road, Lidcombe NSW 2141. In addition to the development of the type N thermocouple and Nicrobell sheath material, he has also been responsible for much of the development of the so-called "MIMS" or mineral insulated, metal sheathed construction shown in Fig.8. This is rapidly becoming the preferred construction for all high temperature thermocouples.

A feature of MIMS construction is that the insulation between the actual thermocouple wires and the metal sheath is formed from a material such as magnesium oxide powder, which is initially only loosely packed. The mechanical and thermal characteristics of the sheath are also matched closely to those of the thermocouple wires. The complete assembly is then drawn or swaged down to the required final diameter, rather like drawing wire or optical glass fibre.

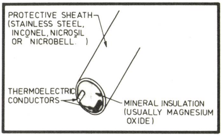

PROTECTIVE SHEATH (STAINLESS STEEL, INCONEL, NICROSIL OR NICROBELL)
THERMOELECTRIC CONDUCTORS
MINERAL INSULATION (USUALLY MAGNESIUM OXIDE)

Fig.8: Construction of the mineral insulated, metal sheathed or MIMS type of thermocouple, which can be drawn down to diameters as low as 0.5mm. (Courtesy Bell-IRH)

This allows the production of highly stable and rugged thermocouples with diameters as small as 0.5mm!

For basic temperature measurement using thermocouples, very little electronics is required. Apart from the actual thermocouple itself, all that is needed is a DC millivoltmeter capable of allowing accurate measurements up to about 75mV. Next month I hope to describe a simple and low cost high temperature thermometer, using a type K thermocouple, and suitable for measuring temperatures up to around 900°C. Just the shot for checking the temperature of small heat treatment furnaces, as it happens! EA

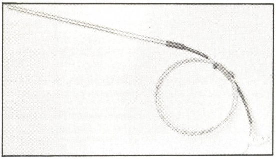
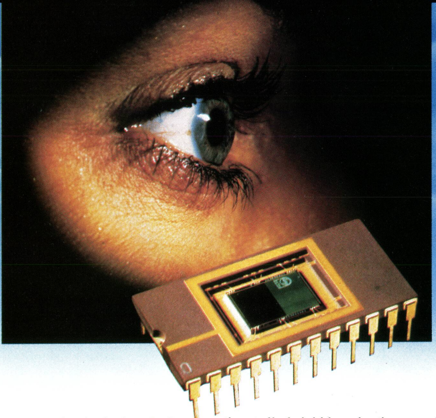


Fig.7: A small low-cost type K thermocouple in a stainless steel sheath, made locally by the firm Richard Foot.

The things ICs will make possible...



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CAD, CAM, CAE and CIM - the basic concepts

Most people in electronics will have become aware by now that computers are being used more and more as tools for designing, drafting and manufacturing. At the same time many people are understandably a bit hazy about how it's all done, what the advantages are and the exact meaning of terms like CAD, CAM, CAE and CIM, which are often used rather ambiguously. Here's an attempt to clarify the basic concepts.

by JIM ROWE

To start with, it would no doubt be a good idea to tackle those acronyms, and have a go at clarifying their meaning.

First of all, there's CAD, which originally stood for *computer-aided design*. In other words, the use of a computer with suitable software as a tool for the engineering design of any desired product or system. The problem is that in the last few years, this term has also come to mean *computer-aided drafting* — a rather more narrow application, where the computer is used mainly to replace a drawing board and drafting machine for the efficient production of plans and drawings.

Because of this ambiguity, some people have started to use the acronym CAE instead of CAD, where the broader *design* meaning is intended rather than simply drafting. Here CAE stands for *computer-aided engineering*. But this can introduce a further problem, because many software packages which turn a computer into a true design tool also make it into a drafting tool, as part of the overall package. So the two tend to be linked, almost inextricably. All one can say is that many "design" CAD packages also provide drafting capabilities (often integrated with the rest of the package), while some "drafting" CAD packages provide not a great deal more than that.

In view of this linkage, it's probably still best to use the term CAD as the generic label for all of these packages, and to regard the drafting-only packages as a 'limited capability' sub-group. That's the approach we'll be taking in the current EA article and feature, anyway.

Another term you'll come across more and more in this area is CAM, which stands for *computer-aided manufacturing*. In other words, the use of computer-controlled machine tools and other production equipment. There's also CNC, short for *computer numerical control*, which is largely used to describe machine tools designed to accept programs from, or prepared using, a computer. Often CNC is shortened to simply NC, for numerical control.

And finally there's the term CIM, short for *computer integrated manufacturing*. This is a more recent concept, where all of a company's process controllers, numerically controlled machine tools and computers are integrated into a complete system to allow total control. So the design for a product can be prepared on the engineering department computer, which then gets the purchasing department's computer to order the parts and schedule production. When the parts arrive, the production control computers and NC machines are supplied with the machining programs, so that they "know how to make them". Then when the products are shipped out of the door, the production computer and the despatch department computer send all of the details to the accounts department computer, which prepares the invoices and sends a report to the management computer. And so on. (It all sounds wonderful in theory, but no-one seems to have actually achieved true CIM in practice — perhaps that's a good thing, too!)

Getting back to CAD, the basic concept is really quite simple. Designing many of today's hi-tech products can be a massive job, and if done using traditional methods it can take a lot longer than modern industry can afford. Time is money, after all — particularly when the time is being spent by a highly trained design engineer. So when computers came along, it was logical to try and take advantage of these as design tools, to speed things up.

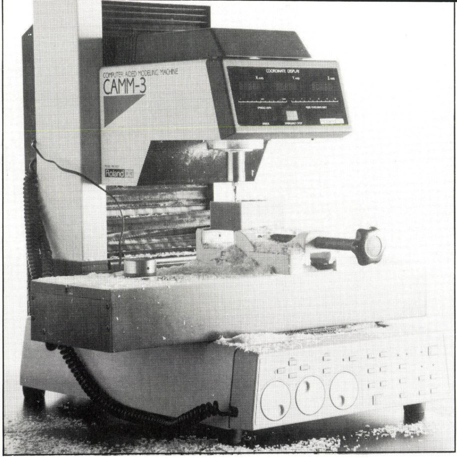
Generally the idea is that with suitable software, the computer can take over a lot of the tedious repetitive calculations which form much of engineering design. And it can often be arranged to display the results of those calculations in easy to appreciate graphical form, again using suitable software.

From this basic concept, many fancy developments and elaborations have grown. In some cases the CAD software packages have grown into virtually "expert systems", encapsulating the knowledge of an experienced design engineer so that even an inexperienced tyro can turn out complete products without really knowing how it's done.

In other cases, the CAD package provides all sorts of extra features and facilities, to allow the experienced designer to do things formerly not possible. Things like simulating the operation of the final product even before it's built, and allowing you to measure its performance — then allowing you to change the design, and see the effect of those changes. And so on . . .

Now before we end this introduction, we should look briefly at the kind of hardware and software that are needed for virtually any kind of CAD.

Obviously you need a computer and one of the CAD software packages designed to run on it, for a start. When CAD first came on the scene, you needed a mainframe computer, or at



This new computer-aided modelling machine from Roland Corporation hooks up to a PC-based CAD system and will automatically machine a prototype from wax, plastic, wood or light metal. Further details are available from Roland on (03) 241 1254.

least a fairly powerful mini, but in the last few years personal micros have become so powerful that they're now quite capable of being used for CAD as well.

Techniques have also been found whereby CAD software packages could be "scaled down", so they would fit into smaller computers and run satisfactorily in them. In many cases this has involved things like limiting graphics resolution and maximum drawing size, in order to fit co-ordinate data into 16-bit data words, but for most general applications this is of no great concern. For example many of the smaller PC-based CAD packages are limited to a resolution of .001" as the smallest pixel size, and to drawings of no more than 32.768" (832mm) square — but as you can see, this would scarcely be a problem for the vast majority of applications.

From a practical point of view, the nett result of all this is that nowadays there's a great deal of very worthwhile CAD software designed to run on machines like the IBM PC/AT and its clones, in particular. And most of this software runs very well, particularly if the computer is fitted with the optional 80287 maths co-processor chip to speed things up. (Many CAD functions involve a lot of number-crunching.)

Apart from speed, an important requirement for the computer itself as far as CAD is concerned is its graphics capability. Naturally CAD makes extensive use of graphics, and generally high resolution colour graphics at that. So you need a machine fitted with at least an extended graphics adaptor or "EGA" (or better still, one of the even higher resolution boards now becoming available), coupled to a suitable high-resolution RGB colour monitor. Both of these are really essential for serious CAD work.

It's also important to have plenty of main memory and mass storage — main memory because the CAD software programs tend to gobble up quite a bit themselves, and mass storage because CAD is very graphics orientated, and its graphics data files occupy a lot of storage space. In most cases this means at least 640K bytes of main memory, and a hard disk drive with a capacity of at least 20 megabytes. Ideally the disk drive should also be of the voice-coil actuated type, which gives faster and more reliable operation.

Apart from the computer and CAD software package, you will also need an output device like a printer or X-Y plot-

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ter. Many CAD packages will give quite good results with a relatively low cost dot-matrix printer, providing it can perform graphics. But if you can afford one, a laser printer will generally give better results because of its greater resolution (typically 300 dots/inch, compared with about 80 dots/inch). This assumes that the CAD package you're using knows how to drive the laser printer to achieve the better resolution, of course, but most of the latest packages are capable of doing this.

The alternative to a printer is an X-Y plotter. Plotters are generally capable of rather better results, particularly the more expensive variety — but they do tend to be very expensive. For a lot of applications, the extra cost isn't really justified.

In many professional CAD applications, a dot-matrix printer is used to get "working draft" copies of the CAD system output designs. Then when all seems well, the designs are sent in the form of files on floppy disk or magnetic tape to a bureau with a photoplotter, to produce the final "pretty" artwork. This can be a very cost-effective solution, allowing you to get the excellent quality available from a photoplotter without being up for its heavy capital cost.

A SHORT GLOSSARY OF CAD TERMS

CAD: Either computer-aided design, or computer-aided drafting. The use of a computer system as a tool for either the engineering design of a product, or at least for producing circuits, patterns, drawings or plans.

CAE: Computer-aided engineering. A term used by some instead of CAD, to mean the wider use of a computer system as an engineering design tool.

CAM: Computer-aided manufacturing. The use of computers to control manufacturing processes, preparing programs for machinery such as robots and numerically controlled machine tools.

CIM: Computer integrated manufacturing. The technique of tying together all of a manufacturing organisation's computers, including those controlling the manufacturing itself, so that they communicate directly and form an integrated system.

CNC: Computer numerical control, often shortened to NC. Used to described machine tools and process plant designed to be controlled automatically by a programmable computer using digital data files.

ICONS: The display symbols used in CAD systems to represent the components of the system or graphics they're being used to design or draft. Usually stored in databases, known as "icon libraries". Alternative icon libraries can be used to adapt the CAD system for different applications.

NET LIST: A shorthand description of the components in a CAD design or graphic file, and their interconnections. With CAD systems used for electronic circuit design and PC board pattern routing, the net list is generated by the module used to draw the schematic circuit, and then used by the automatic PCB routing module.

SIMULATION: A feature provided by some of the more advanced CAD packages for electronic circuit design, whereby the system is able to show you how the final circuit will perform.

It's possible that in some cases you might need a scanner, for feeding special custom symbols into the CAD drafting package library, direct from artwork. However this is not often needed, and you can probably get the scanning done for you by an outside bureau on the rare occasions that it is.

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SPECIAL FEATURE:

The roles of CAD in electronics

Although computers can now be used as design and drafting tools in many different fields, they're probably still of greatest value in the industry which spawned them: electronics. Here they are rapidly becoming almost indispensible in the design of a great many products, but particularly things like printed circuit boards and integrated circuit chips. This article gives a broad overview of the current state of the art . . .

by JIM ROWE

In looking at the main areas where CAD has been applied in electronics, I think the best idea is to start with the simplest and easiest to understand, and work our way up to the fanciest.

Probably the simplest application is as a pure drafting aid, for drawing circuit diagrams or "schematics", and perhaps PC board patterns. Here the CAD package is being used purely as a hi-tech replacement for the traditional drawing board/drafting machine setup, and/or the adhesive pads and tapes which are still used to produce PCB patterns by the manual method.

In a sense, this application of a CAD package is rather like using it as a fancy set of electronic drawing stencils. It provides a large "library" of symbols or *icons*, from which you can call up any one at will, adjust its size and orientation, and place it accurately where you wish on the diagram or pattern you're producing. Then you can join up the various icons using a variety of connection lines. When the whole thing's finished, you can produce a copy on paper using a dot-matrix printer, laser printer or X-Y plotter.

For producing a circuit schematic, you use a library of circuit symbol icons; for producing a PCB pattern you use a library of component and IC package mounting pad icons; and so on.

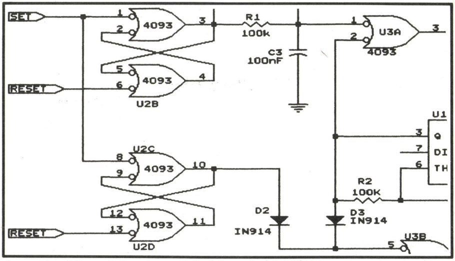
With the simplest computer-aided *drafting* packages, these functions are largely all that you can do. Others provide the ability to check for basic errors, add notation and component values, and perhaps generate a "bill of materials" to aid in ordering the parts required. In some cases they might also be capable of producing a *net list* — or shorthand description of the components and their connections, for use by other CAD modules or packages.

With the more elaborate packages, it's often possible to buy just the drafting module initially, and use it in this way until you're ready to add the other modules to make things more automatic.

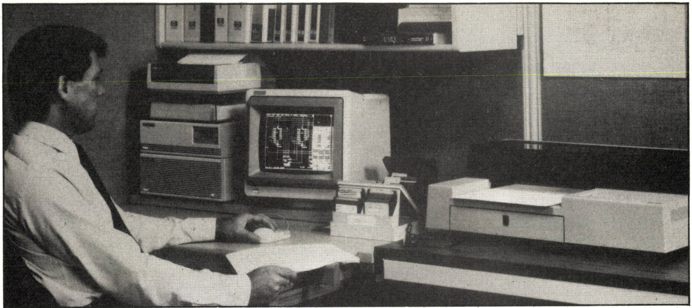
Incidentally a CAD package can be "customised" for doing this kind of simple drafting in almost any discipline, just by providing it with the appropriate library of icons. You can use it for producing house plans if you wish, by providing it with a library of icons for doors, windows, washbasins and WCs; or for producing landscape gardening plans, with a library of icons for shrubs, trees and garden beds. For basic electronics drafting, it's merely a matter of providing it with the right library of icons for circuit components and PCB pads.

Needless to say, this basic kind of CAD package allows you to produce a square, tidy and fairly professional looking schematic or PCB pattern. And you can do this quickly and efficiently — once you've got the hang of driving the package itself.

It's true that some people find the circuit schematics produced by many of the CAD drafting packages not as attractive or as easy to follow as those produced by a good, experienced human draftsperson using stencils and a drafting machine. That seems to be because the simpler CAD packages often produce only one basic line thickness, used for virtually everything; there's no easy way to give various parts of the



A sample of the printout (actual size) from OrCAD/SDT, a schematic circuit design tool, made using a Star SG15 printer. Full annotation is provided. (Courtesy Prometheus Software)



The Hewlett-Packard HP 9000 series 300 workstation, being used for schematic circuit capture. (Courtesy Hewlett-Packard Australia)

drawing extra emphasis, by giving them a heavier line weight (e.g., transistor and IC symbol outlines).

Many of these criticisms are overcome by the newer and more elaborate packages, which give you a wider choice of icons in their "library". In some cases they also allow you to customise the library icons yourself, so if you want a stronger outline around your IC symbols, you can give them one. Similarly if you find the resistor zig-zag icons too "stretched out", you can make your own one with tighter spacing.

Note that even if the supplier of the CAD system software doesn't supply a variety of different sets of symbols, you'll often find that other companies do supply alternative symbol libraries. For example the firm Edutech Productions in Melbourne (see product section following this article) can supply icon libraries for the well-known package AutoCAD, designed to tailor it for a variety of different applications such as industrial electronics, electrical contracting, hydraulics and pneumatics.

Of course so far we're talking about what is still essentially manual drafting: for example with a PCB pattern, you're still deciding on where the IC pad symbols go, how they're connected up and where the connecting lines will run. The CAD system is still more or less acting as a fancy drafting machine. The next step is to use it to help you more in the actual design work itself.

Now we're getting into the more general CAD area, of course. Staying with the design of a PCB pattern, you can get the CAD package to actually work out a suitable pattern for itself, using your circuit schematic (which you must obviously have fed in, first!). This is generally termed *auto-routing*. Needless to say, you generally also have to give it a bit of guidance, by telling it things like the size and shape of the PCB you want — and often where you'd like to put the various IC packages.

Even when you give it this basic information and tell it to get cracking, a typical CAD package running on a personal computer can take literally *hours* to produce a trial PCB routing pattern, particularly if the PCB is a fairly complex one with quite a few ICs and a lot of interconnections. Even an AT-level machine fitted with a numeric coprocessor chip can take quite a while, while a minicomputer might not be much faster.

Still, you have to compare these times with the time you'd take yourself to do the same job. There's an awful lot of work in designing a complex PCB pattern — referring to the circuit, looking up the connections for ICs and other devices, working out how to route each connection from A to B without crossing any others (or hopefully requiring any links), and so on. With a complex board, this can all take days, even weeks by the manual method — so the fact that a CAD program may take hours is neither surprising nor unreasonable. Generally you're still going to be well ahead!

Mind you, with complex PCBs, the CAD program can still reach a point where it is literally unable to complete the pattern, having "routed itself into a corner" with nowhere left to put some remaining connection lines. This can happen with almost any of the CAD packages, including the very expensive ones.

In this kind of situation you generally have to look at the attempt it made, and see where it struck problems in the way of connection line "bottlenecks". This will usually give you a clue as to the kind of changes in position (and perhaps orientation) of some of your main IC packages, that seem likely to ease the problem. Then you need to make these changes and tell it to "try again". Sometimes it can be necessary to make these kinds of changes a number of times, until a satisfactory PCB routing solution can be achieved.

Of course designing a PCB isn't just a matter of fitting all of the ICs and other devices into the required number of square millimetres, together with all of the necessary interconnections. There are other requirements, necessary so the resulting circuit will perform correctly from an electronic point of view. Critical signal lines must be kept as short and direct as possible, inputs must be routed away from high-level signal lines so there will be minimum coupling, supply lines must have as low an impedance as possible for minimum noise, and so on.

Generally speaking, CAD packages still aren't capable of helping much in these respects (at least, as far as the packages available for PCs are concerned). They can do all the hack work of producing a solution to the basic routing problem, but it's still up to the

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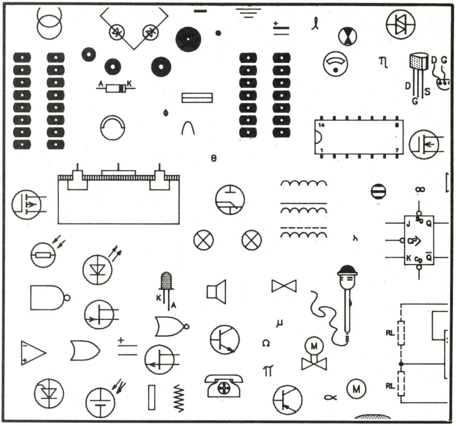


A sample of some of the library icons available for electronic work using the AutoCAD package. (Courtesy Edutech Productions)

engineer to decide whether it's a satisfactory solution in terms of good electronics design. So even when a complete PCB pattern has been achieved, it can still require further component juggling and re-runs to achieve a design which seems capable of the right electronic performance. Rome wasn't built in a day!

As well as producing the PCB pattern, a CAD package can often also produce a bill of materials for the components required, as noted earlier. It may also be able to produce matching patterns for the PCB solder resist masks, and for the component identification pattern to be silk-screened on the top of the resulting PCBs. In some cases it can even be arranged to produce a "program" to guide a numerically-controlled drilling machine, in drilling the holes for the resulting PC boards.

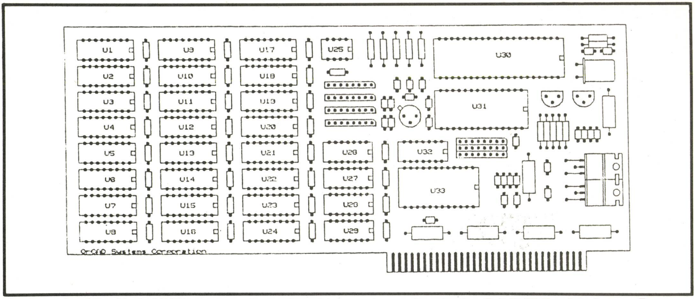
In short, the more elaborate CAD packages can take your circuit schematic, and can at the very least help you greatly in designing virtually all aspects of the necessary PC board, if not perform a lot of this design for you.

The latest CAD packages and versions of existing packages are now adding a further string to their bow: the ability to take the net list which describes your circuit, and *simulate* its electronic operation using the information stored in its database on the behaviour of each component used, and the way they're connected.

When you run one of these simulation modules, it can show you the circuit voltages and currents and how these will alter with input signals and other changes. You can can look at circuit waveforms and logic levels, just as if you'd built up a prototype of the circuit, and were checking its operation with a scope or a logic analyser.

Up until recently this kind of simulation was only available on very expensive mainframe and large minicomputer CAD systems, because it involves a lot of number-crunching. However simulation packages are now becoming available for PC-based CAD systems, and at surprisingly reasonable cost.

Both digital and analog simulation packages are available. For example the newly released package OrCAD/VST provides simulation of digital circuits produced using the same company's well-known OrCAD/SDT schematic design tool, while the package PSpice provides simulation of analog circuit operation. The latter package is a PC implementation of the famous SPICE analog circuit simulation program developed originally at the University of California



An example of the kind of PCB components overlay which can be produced using OrCAD/SDT, printed on an Epson FX80. (Courtesy Prometheus Software)

at Berkeley, and will also accept net lists produced by other CAD packages. Both OrCAD/VST and PSpice are available from Prometheus Software Developments, in Melbourne.

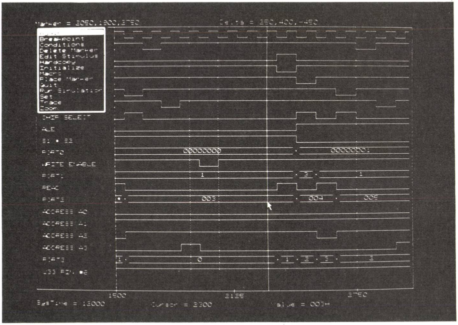
Perhaps the other main application of CAD in electronics, apart from circuit and PCB design/drafting, is in IC chip design. In many ways this is a similar kind of application, with the products just "scaled down" a couple of orders of magnitude. From a basic design point of view, an IC is essentially a very small PCB and set of components, all integrated inside a chip of silicon. Of course it's not quite that simple. Because the components *are* integrated together inside the silicon, there are all sorts of possible interactions and design complications. In fact almost every monolithic circuit component — whether it's an "active" part like a transistor or FET, or a nominally "passive" part like a resistor — tends to be unavoidably accompanied by at least one additional *parasitic* component (usually another transistor). These parasitic components are inherent in a monolithic IC's structure, and can have a crucial effect on circuit operation.

So designing an IC does tend to be rather more complex than designing a discrete circuit or PCB, and to involve a great deal more expertise. In practice this tends to mean that CAD systems for IC design have to be rather more powerful, and need to run on large mini and mainframe computers. Because of the very fine detail required, it is also necessary to use extremely high resolution colour graphics displays and plotters.

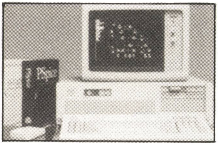
It's also interesting that because of the circuit design complications produced by parasitic components and other solid-state electronics effects within an IC chip, designing even a "digital" chip tends to involve a lot of work using *analog* design tools. So the designer of a new logic chip often has a need to use an analog circuit simulation tool like SPICE, to look at the performance likely to be obtained. When you get down to the IC chip level, the differences between analog and digital tend to become very blurred!

Generally it's true to say that CAD design tools are now virtually essential for the design of most ICs. The ICs themselves are becoming more and more complex, while commercial pressures are making it necessary for designers to produce them in proportionally shorter times. It just wouldn't be possible to meet these requirements without the powerful help provided by CAD.

For simple one-off or short run circuit boards, or knocking out the odd circuit schematic, traditional manual techniques are still probably the best approach. But in industry, CAD design tools are now almost essential. ⒺⒶ



The display produced by OrCAD/VST, the new digital simulation package which allows you to "breadboard" and check the operation of a logic circuit before it is actually built. (Courtesy Prometheus Software)



Analog circuit simulation

PSpice brings the capabilities of SPICE and more to a personal computer.

By using an easy-to-learn input format, you enter a circuit description into an ordinary text file with any text editor on your PC, or use the schematic interface from many of the popular PC-based CAE packages. Then PSpice is run to analyse the circuit you have described. The results are available on your monitor, on a printer or plotter, or may be saved in a file for later reference. Results can be viewed interactively with high resolution, graphical output.

PSpice allows you to simulate your circuit designs before touching the first piece of hardware. The response over time to different inputs, the frequency response, the noise, and other information about your circuit are all available. In effect, PSpice allows you to do a "computer breadboard" of the circuit before building anything.

The Probe option lets you check results with high resolution, graphical output. Information about any of the nodes in the circuit may be analysed interactively without rerunning the simulation.

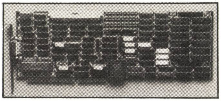
The Parts option helps you extract device model parameters from the manufacturer's data sheet specification. Interactive, graphical feedback lets you check that the device characterisation has been done correctly.

PSpice will run on the IBM-PC/XT/AT, Compaq 386, or any IBM-PC compatible computer with 512K of memory, the floating-point co-processor (8087, 80287 or 80387), and DOS 2.0 (or later). Double precision (64 bit) arithmetic is used throughout, including AC and noise analysis where the real and imaginary parts are each double precision.

With 640K of memory on the IBM-PC/AT PSpice will simulate circuits with up to 200 transistors. On the IBM PC/AT PSpice runs one-fourth the speed of SPICE on a VAX11/780 (both machines equipped with floating-point hardware).

Interfaces are available for popular PC-based schematic editors including those from Aptos Computer, Case Technology, FutureNet, Omation, OrCAD, P-CAD and Viewlogic. Using one of these packages you can go directly from schematic to simulation.

Prometheus Software Developments, 191 Riversdale Road, Hawthorn 3122.



Ultra-fast graphics

A new range of microcomputer graphics monitors which can pan, zoom and redraw images up to 20 times faster than comparable screens, has been launched on the Australian PC market by Comprador Business Systems.

The range, called Xcellerator, is claimed to be the world's first graphics system for micros to incorporate the revolutionary TI34010 third-generation Texas Instruments graphics processor chip. The manufacturer is Cambridge Computer Graphics of Cambridge, England.

The Xcellerator range is designed for users of IBM PC/AT computers and compatibles who need to produce large drawings particularly architects, engineers, graphic artists and desktop publishers. It comprises two 19" high resolution display monitors — a grey scale with eight shades of grey version, and 256-colour version — and three graphics controller cards.

Instead of waiting many seconds for conventional screens to zoom or pan, an Xcellerator user can perform all these functions on a 2-D CAD design almost instantaneously.

Similarly, users producing 3-D designs can programme the system to handle 3-D projection and rendering, and in engineering applications, wire frame models can be rapidly transformed or viewed from new angles.

Xcellerator software drivers are available for most standard CAD and graphics packages including AutoCAD, MS Windows, Campaint and Personal Designer. In addition to these screen drivers, Comprador can provide software tool kits which enable users to develop their own. A typical Xcellerator colour screen with 1Mb of memory would cost about $14,000.

For more information contact Comprador Business Systems, 90-94 Warren Road, Smithfield 2164.

Analog simulation system

The CAE Systems Division of Tektronix has announced the HSPICE simulation system which provides an integrated environment for analog circuit design and verification.

The HSPICE Simulation System provides tight integration of Tektronix Designer's Database Schematic Capture (DDSC) program, and Meta-Software's popular HSPICE analog circuit simulation software. Offered as an option to Tektronix PCB WorkSystem, the system allows the design engineer to develop and analyse analog designs within the powerful, easy-to-use DDSC environment.

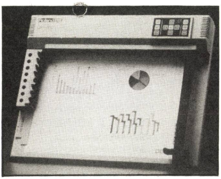
Tektronix DDSC is the controlled repository of circuit or system graphical, electrical and parametric data. DDSC accommodates "team engineering" by allowing designers immediate transparent access to design data resident anywhere on a network. Multiple windows can display design and simulation results simultaneously, different designs for side-by-side comparison, or sections of a design.

Meta-Software's HSPICE circuit simulator program offers exception convergence handling, a greatly enhanced feature set and highly accurate discrete component models developed by Meta-Software's Device Characterization Laboratory.

A super-set of the defacto industry standard SPICE circuit simulator, HSPICE provides analog circuit verification through AC, DC or time domain analyses. Information may also be obtained for noise, distortion, resistor power consumption, fourier analysis and a variety of other comprehensive reports.

The HSPICE Simulation System includes Tektronix HSPICE interface Meta-Software's HSPICE and HSPLOT programmes, a starter discrete component model library and a library of HSPICE primitive elements.

For further information contact Tektronix Australia offices in Sydney, Melbourne, Adelaide, Brisbane, Canberra and Perth.



Eight pen A3 plotter

The new Roland DXY880 eight-pen A3 plotter can provide cost-effective hardcopy output for business graphics and CAD software. The manufacturer claims it is compatible with more software than any other plotter on the market.

Operating at a plotting speed of 200mm per second in any direction and with a resolution of 0.05mm per step, it is suitable for precise line graphics or overhead transparencies. It will also run with Lotus 1-2-3, Symphony, In*a*Vision, AutoCAD, VersaCAD, pfs Graph or Window Draw. It can also be custom programmed.

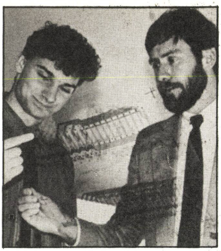
The DXY 880 is available through Dick Smith Electronics stores and is priced at $2250.

Dick Smith Electronics, Cnr. Lane Cove & Waterloo Roads, North Ryde 2113.

Photoplotting service

Precision Graphics offers a variety of bureau services to electronics designers using CAD systems, including photoplotting of PCB patterns, mask patterns and other artwork. The company has facilities to accept plot files from a wide range of CAD systems. It is also a dealer for the Australian-developed Protel suite of CAD programs.

Further information from Precision Graphics, Unit 15, 31 Waterloo Road, North Ryde 2113.



RCS Design MD Ray Smith and PCB designer Phil Bruggeman discussing photoplot output.

Phototools from PC software

RCS Design is offering high quality photoplot outputs from 5-1/4" floppy disks prepared on the many personal computer software CAD packages for printed circuit board design.

The phototools are produced on a Gerber photoplotter and are accurate artwork masters at full size ready for the printed circuit board manufacturer.

Typical sets of artwork masters might consist of negatives for component side and solder side trackwork, component legend, solder resist and drill pattern. This procedure is possible for producing all types of boards from single sided to multilayer and SMD.

As well as photomasters, RCS Design can generate NC drill tapes for numerically controlled drilling of the boards.

RCS Design engineers have prepared a booklet describing the setup procedures for photoplotting from personal computer generated files and this is available free of charge.

Details of the plotting service, or any other engineering support services offered, which include full PCB design and documentation can be obtained directly from RCS Design at 728 Heidelberg Road, Alphington 3078.

Ultra friendly CAD software

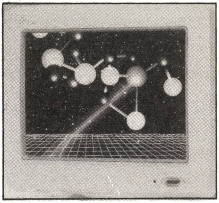
Drafix 1 and Drafix 1 Plus are claimed to be the easiest to use CAD software available for general purpose drafting, made possible through a dynamic screen menuing system. All of the menus are visible at all times, making it unnecessary to memorise menu hierarchies.

When a function includes optional features, a "roll down" menu automatically appears to display all of the available options.

Simplicity and elegance are said to make Drafix well suited for use by graphic artists, facility planners, interior designers and students. However it is also claimed to provide the full CAD features required by architects, engineers, drafters, contractors and manufacturing designers.

Features include powerful graphics editing commands, 11 library fonts (16 for Drafix 1 Plus) and 14 cross-hatch patterns, automatic dimensioning, and the ability to produce drawings for paper sizes A to E (A4 to A0). Optional extras include software drivers for dot-matrix and laser printers, and a library of 450 icons for architectural, engineering and general applications.

Further information from Discware, 5th floor, 3 Smail Street, Broadway 2007.



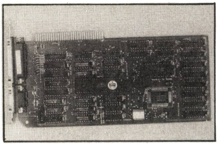
PGA colour monitor

Recently imported from Japan, the IDEC Multiflat monitor is a 15" flat face multisync RGB colour monitor ideal for the graphics and CAD environment. It is compatible with all three graphics boards made by IBM — PGA, EGA and CGA. It uses a 90° deflection tube with 0.31mm dot pitch.

The monitor's maximum resolution is 800 dots by 560 lines and it is cased in the new type flat square CRT. It has a greater range of scanning frequencies than the NEC Multisync, with an automatic horizontal scanning frequency range from 15.75 — 37kHz and 50-70Hz vertically.

It will be available through recommended retail outlets.

For further information contact Porchester Computers, 177 Barkly Street, St. Kilda 3182.



High speed monochrome graphics for PCs

The Turbo Monochrome Graphics card from Electronics Solutions improves the performance of IBM PCs and compatibles by speeding up scrolling and writing to the screen by over four times. The card is fully Hercules Graphics compatible and runs all existing graphics based software.

Slow scrolling is a particular problem with graphics based wordprocessors like Microsoft Word and with many of the new desktop publishing programs.

The board is very complex electronically but most of the new technology has been built into one powerful gate array chip. As a result, the board will fit in a "short slot" of many PCs on the market.

Price is very reasonable at only $175 including tax. Competing products sell for over $700. A low cost fitting service is available.

For further information contact Electronic Solutions, PO Box 426, Gladesville 2111.

Advanced CAE/CAD software

Mentor Graphics has developed a range of advanced software products and systems which operate on the Apollo Domain DN3000 workstation. The Mentor Graphics IDEA system consists of a set of software tools which allow the user to design and simulate his semi-custom gate array chip before proceeding with manufacturing. The tools are also suitable for PCB design.

Australian electronic equipment manufacturer Impact Systems installed its first Mentor Graphics system late last year, and recently acquired a second system. The new Domain DN3000 will be used for gate-array design in parallel with the first system but would mainly be used in the design of printed circuit boards.

With the two Mentor Graphics systems fully installed Impact is said to have drastically improved its ability to quickly turn new ideas into innovative products.

Mentor Graphics' Australian manager, Mr Alain Legrand said Impact Systems is the latest of a growing list of companies investing more heavily into top-end CAD/CAE. "What we are seeing is a general top-end disillusionment with PC-based CAD packages" he said. "They are good value when small designs are involved but lack the power and flexibility needed for larger, more complex design".

Further details from Mentor Graphics (Australia) Suite 404, 77 Berry Street, North Sydney 2060

CAD software tools

Using the very versatile AutoCad as the graphics editor, the Satcam system gives the user a comprehensive set of totally integrated software for the creation of fast efficient manufacturing tools and documentation from schematics through to net lists, part lists, photoplots, manufacturing detail drawings and associated NC driver tapes.

Satcam consists of four modules and is built around a very comprehensive and portable library containing many thousands of parts.

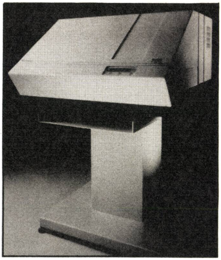
The other parts of the package are:

- Schematic drawing module — a fast professional replacement for the pencil.
- PCB design module — an interactive design package fully integrated with the schematic module.
- Tooling package — supplies drivers for most modern output devices, including Gerber driven photoplotters. Also creates mechanical drawing from the PCB design.
- Auto-routing package — soon to be released, the most versatile and useful auto-router available on a personal computer.

Support offered to Satcam users is claimed to be unrivalled and bureau support is provided in three states. This bureau support covers all aspects of the products' use, from training through to the availability of emergency personnel for customer overload situations.

Printed circuit board manufacturing is also offered to back up the designer, from the group-owned precision circuits which supplies fast, good quality plated thru-hole and single sided boards at very competitive prices.

For further information on Satcam contact Delen Corporation (formerly International Database) Suite 2, 1st Floor, 366 Maroondah Highway, Nunawading 3131.



Low cost photoplotter

The EMMA 210 photoplotter is a member of Marconi's MIDATA range. It is a compact desktop unit featuring linear motor X-Y coordinate drives coupled with high resolution positioning controls giving throughput speeds of 150mm/sec.

In addition there is an extensive selection of images plus fifty factory-set firmware macros and 260 user definable macros for defining plotting patterns such as SMD footprints.

The EMMA 210 accepts data from a variety of source media in different formats by means of a floppy disk converter and the more traditional use of metal tape. The unit is the first in a new line of plotters from Marconi Instruments.

Marconi Instruments, 2 Giffnock Avenue, North Ryde 2113.

Simulation-verifier for OrCAD

OrCAD Systems has announced the new OrCAD/VST (Verification and Simulation Tools), an event-driven digital logic simulator. This low cost, IBM PC-based CAE design tool enables the design engineer to increase design efficiency while dramatically reducing cost.

OrCAD/VST uses the same easy to use pop-up menu structure as provided in the popular schematic design tools packages OrCAD/VST.

With OrCAD's virtual display screen, up to 50 signals or buses can be displayed. If more signals are displayed within the trace editor than fit on the monitor, you can quickly pan to display any portion of the trace display. Trace information is stored on disk, allowing you to run a simulation and later view and restructure the display.

Data analysis is quick and easy. Interval time measurements can be performed by placing up to three markers on the display. Once placed, the time of the marker is displayed and the time delta between the marker and cursor is also displayed on the screen. By moving the cursor to the desired waveform, the signal or bus value is also displayed. This feature is very useful when the bus value does not fit within the confines of the bus being displayed.

OrCAD/VST comes complete with a comprehensive library that includes models of all popular TTL, ECL, CMOS and memory devices. New models are easily developed using the complete set of primitives and components modelling program which are supplied with OrCAD/VST.

OrCAD/VST runs on IBM PC/XT/AT or compatibles, and supports most common graphics adapter boards, printers and plotters. It requires 512K of system memory and either a hard disk or two DSDD floppy drives.

Prometheus Software Developments, 191 Riversdale Road, Hawthorn 3122.

Schematic design program for PCs

Protel-Schematic is a low cost, high performance program for creating schematic diagrams of digital and analog circuits. It can be used as a stand-alone design package or if used in conjunction with the Protel-PCB and Protel-Route programs, forms part of a powerful automatic printed circuit board design system.

Protel-Schematic is supplied with more than 2000 components in its libraries with facilities to create additional user designed components as required.

A special feature of the program is its text creation ability. Apart from placing text on components it is also possible to place free text on the drawing by invoking a word processing function.

The program allows you to produce individual schematic diagrams on sheets up to A0 (Metric) or A (American) size. A net list of components can be produced for individual drawings and this can be used as an input to a PCB layout program.

Many large circuits cannot be contained on a single sheet and these circuits must be drawn on two or more sheets. Protel-Schematic has a simple, convenient method of handling these circuits. A net list can be produced for the complete circuit, even though this may be drawn on a number of sheets.

System requirements are an IBM PC/XT/AT or compatible 256K RAM 2 disk drives (floppy or hard), PC-DOS or MS-DOS Version 2.0 or later, CGA, EGA & HGA Graphics Adapter. Recommended retail price of the product is $890 plus tax if applicable.

Further information from Technical Imports Australia, Suite 602, 202 Pacific Highway, Crows Nest 2065.

Icon libraries for AutoCAD

Edutech Productions has released four new icon libraries to adapt the well-known AutoCAD design and drafting package for different applications.

The Timing and Motor Control library provides icons for industrial electronics applications, to AS 1102 part 11 (1981). The Electrical Contractor library provides icons for the design and layout of building wiring, to AS 1102 part 8 (1983). The Electrical and Electronic library provides icons for schematics, logic diagrams and PCB patterns, to Australian standards. And the Hydraulic and Pneumatic library provides icons for preparing circuit diagrams for these technologies.

All four libraries mesh correctly with AutoCAD and provide custom menus. Each library is priced at $250 plus tax if applicable.

Further information from Edutech Productions, 70 Greenhill Road, Bayswater North 3153.

CAD for hybrid circuit design

Hewlett-Packard has added the hybrid circuit design module HP 74307A for thick-film circuits to the HP Engineering Graphics System HP 74305A.

The hybrid circuit design module is a low-priced CAD system that provides a variety of tools to decrease hybrid circuit development time, increase product quality and reduce overall project costs.

Interactive and automatic features specifically tuned for the needs of hybrid circuit designers include:

- automatic thick-film resistor generation;
- starter library containing more than 300 hybrid parts and subparts;
- support of irregularly shaped conductors;
- the ability to add dielectric crossovers with a single menu selection; and
- links from the schematic design module of HP Engineering Graphics System and from the Electronic Design System (HP 74250C).

Designs can be in English or metric units. Parts are automatically entered for designs from material lists generated from the schematic drawing module or a material list entered by keyboard. However, a material list is not required because parts data also can be entered interactively. Designers can use a rat's-nest generator to add connectivity information (airlines) between the parts.

The starter library can be customized and expanded using simple commands such as add line, add polygon, move and copy. Information can be entered using a keyboard, mouse or tablet.

Flexible editing features move, rotate, stretch and mirror one or several parts or conductors on a grid with resolution to 0.00001". Five placement snapping modes assure parts and conductors are placed precisely. Conductor width can vary along individual conductors, and from conductor to conductor. System prompts help designers easily route multilayer conductors.

Designers can generate a connection list from a completed layout, and be assured that it agrees with the connection list from the schematic-drawing module by using a connection-list compare program.

Manufacturing-material lists can include up to 20 fields of data such as part numbers and prices. An area-calculating utility, which measures the paste area on each layer (resistive, conductive and insulating), also generates information for calculating how much ink will be needed. In addition, designers can generate Gerber photoplotter files by using the optional HP Engineering Graphics System photoplotter and N/C drill post-processor (HP 98310A).

Further information is available from Hewlett-Packard Australia, PO Box 221, Blackburn 3130.

CAD software products

With many years of experience in the computer aided printed circuit board design and photoplotting business, RCS Design has extended its services to cover the software and hardware market.

RCS Design now claims to offer the most comprehensive range of CAD solutions for electronics design available from a single source. The software has been carefully selected so that the best package for a given job can be put together.

Racal-Redac has appointed RCS Design as exclusive distributor for Victoria and Tasmania. The Redcad software is a complete design and documentation package and can be purchased as two individual components, namely Redlog and Redboard. Redlog features many simple to learn and use pop-up menus that guide the circuit designer through the preliminary schematic layout stage. All salient criteria for the PCB are accumulated at the point of design on Redlog for input to Redboard, a powerful, flexible, easy to use multilayer PCB design package. It features many automatic functions such as component placement, orthogonal router, power and ground routing, memory routing and via minimisation.

For designers on a tighter budget, the company recommends the popular Protel package. Protel-PCB has been continually improved since it was first released and with the recently released Protel-Schematic and Protel-Route, the Protel family of design software now offers a complete economical CAD solution.

Such well known performers as the Compaq Deskpro series and the NEC APC IV personal computer with their speed and quality graphics have been selected as the platforms for the software. The complete range of Houston instrument and Benson pen plotters are available for hard copy checkplots. RCS Design also offers the Marconi EMMA 210, a smaller format high accuracy photoplotter for firms with less throughput.

Details are available for all these products from RCS Design, 728 Heidleberg Road, Alphington 3078.

Raster photoplotting

The Tennyson Graphics' electronic laser plotter combines the versatility of a rotating drum with the speed and precision of laser optics, for the rapid exposure of high quality phototools.

Printed circuit designs are transferred to the plotting system from a CAD system. Standard Gerber photo plotter input is read into the system from 9-track magnetic tape or IBM compatible diskettes, or transferred through the telephone system by modem.

Tennyson Graphics has also the capability to convert Smartwork and Autodesk Device Interface files into Gerber Photo plotter input files.

The Tennyson Graphics' plotter is a raster plotter, so it has no aperture wheels. All specifications for tracks, pads, mirroring, stop-and-repeats and nesting are entered on an alphanumeric terminal to individual job requirements. A high speed minicomputer, backed by 900 megabytes of disk memory runs exclusive conversion software, to turn the X-Y design into plot ready raster data.

The software interprets draftcodes to tables than can include emulation of both standard and customized apertures. Each set of "apertures" can include up to 96 different track widths and 96 different pad sizes and shapes. In the raster environment exposure speed is independent of trace length, line width and intricacy; exposure can be positive or negative.

The plotter's 40x73 inch format (1010x1850mm) is the largest in the industry. It produces quality photo tools up to 10,000 pixels per square mm. The laser exposes at consistently uniform density and causes no pinholes.

The photo plotting of a 200x200mm double sided PCB with four plots costs only $245. The turnaround time is less than 48 hours.

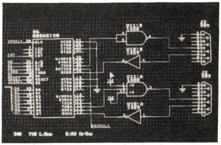
For further details contact Tennyson Graphics on (03) 579 0424.

PCB routing program

Protel-Route is a low cost automatic track router for printed circuit board design. When used with the Protel-PCB artwork editor and the Protel-Schematic capture software, the routing package provides a significant productivity advantage over manual routing.

Protel-Route features powerful nine pass autorouting plus optimisation. Menu driven, the program is easy to use and can be tailored in its operation to specific board designs. Professional quality routing is accomplished with board manufacturing and cost in mind.

Features include the ability to route four layer boards, including two signal layers plus power and ground planes; maximum board size 32" x 19"; and the ability to accept netlists from Protel-Schematic, Schema and OrCAD schematic capture packages.



On an 8MHz PC/AT, Protel-Route will autoroute an IBM-PC plug-in board with 90 equivalent ICs in approximately 20 minutes.

System requirements are substantially the same as for Protel-Schematic: a PC/XT/AT with 250K of RAM and two disk drives. RRP of Protel-Route is $890 each plus sales tax if applicable.

Technical Imports Australia, Suite 602, 220 Pacific Highway, Crows Nest 2065.

CAD/CAM system for print, wired circuits

A new CAD/CAM system installed at the Circuit Technology Australia plant at Willetton, Perth is claimed to be the only computerised facility in Australia with the capability to design both printed and wired circuit boards.

Installed at a cost of $300,000, the new system employs Apollo hardware and a combination of Mentor Graphics and PCK Technology Software.

CTA routinely manufactures ElectroWire discrete wired boards at their Willetton, Perth, plant for use in the US defence equipment industry, and also by computer manufacturers in Australia. ElectroWire is CTA's own development of Multiwire technology licensed from PCK Technology of the US.

The Apollo hardware comprises two DN3000 workstations with high resolution 19" colour screen, linked to a DSP90 server processor. The DN3000s incorporate a 68020 central microprocessor and 68881 floating point coprocessor. They have up to 8Mb memory and a 150Mb hard disk.

Mentor Graphics' Board Station software interfaces with the PCK Technology Autorouter. The former enables CTA engineers to perform schematic capture and board layout and to generate all manufacturing data — approximately 90% of the design task. The latter accurately positions the wired electrical interconnections.

Further information from Mentor Graphics (Australia), Suite 404, 77 Berry Street, North Sydney 2060.

TENNYSON GRAPHICS

Tennyson Graphics can do your photoplotting with the speed of light.

Tennyson Graphics are Australia's only company with state of the art laser photoplotting and computer graphics.

So we can photoplot artwork masters of your printed circuit boards with higher speed, higher resolution and higher accuracy than anywhere else in the country.

You can even choose your own non standard apertures on our Scitex Response 280 System. It can also do step-and-repeat and nesting up to 1000 mm × 1850 mm.

And of course we can accept data on tape or floppy disk in industry standard Gerber format.

Tennyson Graphics will be happy to give you the full story if you phone on (03) 579 0424.

TENNYSON GRAPHICS
A DIVISION OF REPROCART PTY LTD
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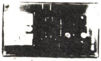
008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER KIT

Here's what you've been asking for, a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are avaialble on interfacing the unit to other computers. (ETI Nov.'84) ETI 755)

Cat. K47550 .... **Normally $135**

SPECIAL, $99

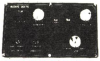


LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms. (ETI Nov.'81) ETI 158

Cat. K41580 .... Normally $44.95

SPECIAL, $39.95



SLIDE CROSS-FADER

Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built varialbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov.'81) 81SS11

Cat. K81110 .... Normally $99.00

SPECIAL, $89.00

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec.'83) ETI 162

Cat. K41620 .... Normally $73.50

SPECIAL, $63.50

MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.

Specifications:

- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing: suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charger circuit.
- Built-in siren driver.

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!

K85900 complete kit . only $159

K85901 without battery backup **$134**

15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage. Includes transformer. (ETI 581, June '76)

Cat. K45810 .... **$34.95**

50 W AMPLIFIER MODULE (ETI 480)

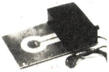
Cat. K44880 **$31.80**

(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)

Cat. K44801 **$34.80**

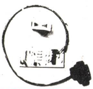
(Heatsink optional extra)



ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again! (ETI Aug.'84) ETI 1524

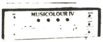
Cat. K55240 .... **$39.95**



RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr.'83)

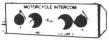
Cat. K47330 **$19.95**



MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety. (EA Aug.'81) 81MC8

Cat.K81080 .... **$114.95**

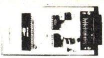


MOTORCYLCE INTERCOM

OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build! (EA Feb.'84) 84MC2

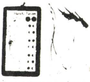
Cat. K84020 .... **$49.95**



MICROBEE SERIAL-TO-PARALLEL INTERFACE

Most microcomputers worth owning have an 'RS232' connector, or port, through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel 'Centronics' interface printers . Save money by building this interface. (ETI Jan.'84) ETI 675

Cat.K46750 .... **$49.50**



TRANSISTOR TESTER

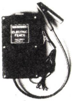
Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept.'83) 83TT8

Cat. K83080 .... **$18.95**

12/240V 40W INVERTER

This 12 240V inverter can be used to power up mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May'82) 82IV5

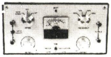
Cat. K82050 .... **$69.95**



ELECTRIC FENCE CONTROLLER

Restore discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design for use in rural areas. (EA Dec.'85, 85ef11)

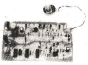
Cat.K85110 **$49.95**



AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder. (81AO10) (EA Oct '81)

Cat. K81101' **$59.50**

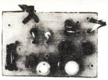


VIDEO FADER CIRCUIT

Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour. (EA Jan '86, 85tf10)

Cat.K86010 .... **Normally $24.95**

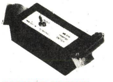
Special, only $19.95



LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give your early warning of power failure, and makes a handy beginner's project. (ETI 280, March '85)

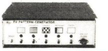
Cat. K42800 **$9.95**



PARALLEL PRINTER SWITCH KIT

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently, so that you can select one or the other at the flick of a switch. (ETI 666, Feb. '85)

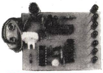
Cat. K46660 **$79.95**



CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superb unit which provides five separate patterns; dot, crosshatch, checker board, grey scale and white raster? **Note:** The RIE kit includes a large ABS type case! (80pg6, EA June '80)

Cat. K80033 .... **$99.95**



HUMIDITY METER

This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI-256 (Includes humidity sensor $19.50)

Cat. K42560 .... **$61.45**

STEREO ENHANCER

The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an 'enhanced stereo effect' with a small unit which attaches to your amp. (ETI 1405, ETI, MAR '85)

Cat. K54050 **$79.50**

THE BUSKER PORTABLE AMPLIFIER

This handy amplifier is completely portable and is capable of operating from either the mains or a 12V battery. Main features include guitar and high-level inputs, an inbuilt loudspeaker, and bass and treble controls. Its just the thing for busking or for guitar practice. (EA Feb. 85 85ba2)

Cat.K85020 (excluding cabinet)**$99**

SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,500 sold!

For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.

POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS" SERIES 5000 POWER AMPLIFIE

- 1% Metal Film resisto

SPECIAL, ONLY $399
SAVE $50

and developed by

ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms (per channel)
POWER AMPLIFIER: 100W RMS into 8 ohms (+−55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0=.0.4 dB 2.8Hz to 65KHz, +0=3 dB. NOTE: These figures are determined solely by passive filters.
INPUT SENSITIVITY: 1 V RMS for 100W ouput.
HUM: 100 dB below full output (flat).
NOISE: 116 dB below full output (flat, 20KHz bandwidth).
2nd HARMONIC DISTORTION: ‹0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a +=56V SUPPLY rated at 4A continues ‹0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above).
INTERMODULATION DISTORTION: 0.003% at 100W. (50Hz and 7KHz mixed 4:1).
STABILITY: Unconditional.

Cat. K44771 .... **$449**

Assembled and tested $599

packing and post $10

PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" SERIE PREAMPLIFIE

- 1% Metal F

SPECIAL, ONLY $359
SAVE $40

believe that dollar for

commercial unit available that sounds as

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz =130KHz, +0.=1dB Low-Level input-conforms to RIAA equalisation +=0.2dB
DISTORTION: 1KHz ‹0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)›92dB flat ›100dB A-weighted, MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected: ›86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal: ›71dB flat ›75dB A-weighted.

Cat. K44791 .... **$399**

Assembled and tested $699

packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

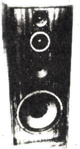
SPECIFICATIONS:
BANDS: 28 Bands

SPECIAL, ONLY $209
SAVE $30

Cat. K44590 .... 1 unit: **$239**

.... 2 units: **$429**

packing and postage $10



SERIES 4000 SPEAKERS

8 Speakers .... **only $549**
8 Speakers with Crossovers .. **$795**
Speaker Cabinet Kit (complete) **$395**
(Please specify cabinet to suit 7" or 8" mid range woofer)
Crossover Kits **$295**
Complete kit of parts (speakers, crossovers, screws, innerband boxes.) **$1,095**
Assembled, tested and ready to hook up to your system ... $1,295
(Approximately 4 weeks delivery)

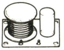
Errors and Ommissions Excepted

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

CROSSOVER NETWORKS

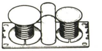
Crossovers are essential for multiway speaker systems, otherwise your bass will be degraded by intermodulation distortion and cone break up, and your treble will be distorted by bass components. These crossovers are designed to channel only the frequencies that each driver can properly handle. Read the specifications to choose the correct one for your need.



2 WAY 60 WATT CROSSOVER NETWORK

- 6dB attenuation
- Cross over point 5,000 Hz
- Impedance 8 ohms

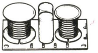
Cat.A16001 .... **$4.95**



2 WAY 60 WATT CROSSOVER NETWORK

- 12dB attenuation
- Cross over point 2,300 Hz
- Impedance 8 ohms

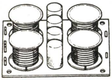
Cat.A16002 .... **$7.95**



3 WAY 60 WATT CROSSOVER NETWORK

- 6dB attenuation
- Cross over point 800 and 5,000 Hz
- Impedance 8 ohms

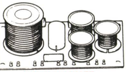
Cat.A16003 .... **$9.95**



3 WAY 60 WATT CROSSOVER NETWORK

- 12dB attenuation
- Cross over point 800 and 5,000 Hz
- Impedance 8 ohms

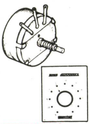
Cat. A16005 .... **$24.95**



3 WAY 150 WATT CROSSOVER NETWORK

- 16dB attenuation
- Cross over point 350 and 3,000 Hz
- Impedance 8 ohms

Cat. A16007 .... **$34.95**



ATTENUATORS

- Ceramic Base - 100 Watt
- Constant impedance 8 ohms
- Complete with metal faceplate and knob
- Mounting holes 66 x 53mm

Mono Cat.A16009 .... **$11.95**
Stereo Cat.A16011 .... **$19.95**

HI FI SPEAKERS

A comprehensive range of matched appearance speakers, all with square silver grey frames and black cones - ideal for building up low cost speaker systems that will look and sound superb.

1½" TWEETER

SPECIFICATIONS:
Sensitivity: 90dB
Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10200 .... **$5.95**

2½" TWEETER

SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 1.1 - 17 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10202 .... **$6.95**

4½" MIDRANGE WITH SEALED BACK

Clothed edge surrounds.
SPECIFICATIONS:
Sensitivity: 97dB
Freq. Response: 600 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10206 .... **$14.95**

6½" WOOFER

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 55 - 7 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 5.4 oz
Cat. C10208 .... **$17.95**

8" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10210 .... **$20.95**

12" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 92dB
Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13.3oz
Cat. C10214 .... **$49.95**

SENNHEISER HEADPHONES!!

The worlds best headphones are now available from Rod Irving Electronics!! 3 models to choose from, other models are available on request! (Phone Tony DiPaolo on (03) 543 2166)

SENNHEISER HD 40

The HD40 is feather light, at just 60g! This HiFi stereo headphone is uncommonly convenient to use. Its systems can be rotated so it can fit into any drawer. It is also available as a TV headphone.

SPECIFICATIONS:
Frequency Range: 22 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Approx. 1.5%; pressure on ear; approx. 1.3 N
Weight: Approx. 60g
Length of lead: 3 metres
Cat. A10515 .... **$49.95**

SENNHEISER HD 410 SL

The HD 410 SL embodies all the advantages of the new "Slim-line" concept: brilliant sound characteristics with an optimum of sound volume combined with high wearer comfort.

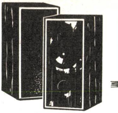
SPECIFICATIONS:
Frequency Range: 20 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Less than 1%; pressure on ear; approx. 2.5 N
Weight: Approx. 82g
Length of lead: 3 metres
Cat. A10518 .... **$74.95**

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

SENNHEISER HD 540 REFERENCE

The HD 540 reference headphones are open dynamic stereo headphones. They are among the best ever made. Designed according to latest findings in acoustics, their reproduction is of extraordinary transparency and the highest transients fidelity. The test with a CD player shows: their acoustic properties are outstanding. The ear cushions play a major role. They provide a completely resonance-free treble reproduction up to 25 KHz and assure an impressively clear bass reproduction down to 16 Hz.

SPECIFICATIONS:
Frequency Range: 16 - 25,000Hz
Impedance: 600ohm per capsule
Harmonic Distortion Factor: Less than 0.4%
Contact Pressure: Approx. 3 N
Weight: Approx. 250g
Length of lead: 3 metres
Cat. A10519 .... **$199**



VIFA/AEM 2 WAY SPEAKER KIT!

This exciting new speaker kit, designed by David Tillbrook (a name synonymous with brilliant design and performance) uses VIFA's high perfomance drivers from Denmark. You will save around $800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. Call in personally and compare for yourself!

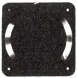
The system comprises...
2 x P21 Polycone 8" woofers
2 x D25T Ferrofluid cooled dome tweeters with Polymer diaphrams
2 pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D25T SPEAKER SPECIFICATIONS
Nominal Impedance: 6 ohms
Frequency Range: 2 - 24kHz
Free Air Resonance: 1500Hz
Operating Power: 3.2 watts
Sensitivity (1W at 1m): 90dB
Nominal Power: 90 Watts
Voice Coil Diameter: 25mm
Air Gap Height: 2mm
Voice Coil Resistance: 4.7ohms
Moving Mass: 0.3 grams
Weight: 0.53kg

P21 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 26 - 4,000Hz
Free Air Resonance: 33Hz
Operating Power: 2.5 watts
Sensitivity (1W at 1m): 92dB
Nominal Power: 60 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.8ohms
Moving Mass: 20 grams
Thiele/Small Parameters: Qm: 2.4
Qe: 0.41
Qt: 0.35
Vas: 80:1
Weight: 1.65kg

Complete Kit Cat.K16020 ... **$799**
Speaker Kit Cat.K16021 .. **$649**
Cabinet Kit Cat.K16022 ... **$209**



PHILIPS SPEAKERS

"Unfortunately we cannot always guarantee Philips speakers to be in stock due to availability problems, nor can we guarantee the exact models listed. However, Philips equivalent or better will be supplied."
-Rod.

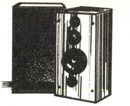
Description	Cat.No.	Price
AD01610T8	(C12030)	$24.95
AD02160SQ8	(C12040)	$69.95
AD80652W8	(C12042)	$69.95
AD070620M8	(C12045)	$69.95
AD12250W8	(C12050)	$129.00

MICROPHONE ECHO ADAPTER (SM100)

Gives microphones "depth". Invaluable when using them in "dead" room/halls etc.

- Echo effects may be varied
- Volume control
- Power on LED
- Fits in line
- Standard 6.5mm socket and plug
- Power 9V battery
- Input low impedance
- Output 30mV (max)
- Signal/noise ratio 40dB
- Delay time up to 60m seconds
- Frequency response 50 - 15kHz
- Cord length 75cms
- Weight 220 grams
- Dimensions 115 x 32 x 44mm

Cat. A10530 .... **$44.95**



VIFA/AEM 3 WAY SPEAKER KIT!

This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
2 x P25 woofers
2 x pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D19 DOME TWEETER SPEAKER SPECIFICATIONS
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20kHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts
(fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2ohms
Moving Mass: 0.2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts
(fo: 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7.2ohms
Moving Mass (incl. air): 3.6 grams
Weight: 0.65kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters:
Qm: 3.15
Qe: 0.46
Qt: 0.40
Vas: 180:1
Weight: 1.95kg

Complete Kit Cat.K16030 **$1,199**
Speaker Kit Cat.K16031 .. **$949**
Cabinet Kit Cat.K16032 ... **$349**

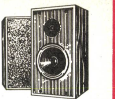
OMNI-DIRECTIONAL WIRELESS MICROPHONE

Tuneable: 92 - 104MHz
Freq. Response: 50 - 15kHz
Range: Over 300 feet in open field.
Modulation: FM
Power Source: 9V Battery
Type: Electret Condenser.
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
Cat. A10450 .... **$19.95**

12" HIGH POWER MUSICAL SPEAKER

- Aluminium die cast chassis
- Carbon fibre impregnated cone paper
- Foam edge
- Light grey cone, silver dust cap
- High temperature "NOMEX" voice coil.

SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 50-4kHZ
Impedance: 8 ohms
Power RMS: 60 watt
Magnet Weight: 30 oz.
Cat. C10216 .... **$82.50**



SUPERB NEW VIFA/EA 60+60 SPEAKER KIT!

The new Vifa/EA 60+60 loudspeaker kit has been designed to completely out perform any similarly priced speakers. This is a 2-way design incorporating drivers which give a deeper, more natural bass response and 19mm soft-dome ferro fluid cooled tweeters which provide clear, uncoloured sound reproduction

These Vifa drivers are identical to the ones used in such fine speakers as Mission, Rogers, Bang & Olufsen, Monitor Audio and Haybrook just to name a few. Some of which cost well over $1,000 a pair!

The dividing network is of the highest quality and produce no inherent sound characteristics of their own; they simply act as passive devices which accurately distribute the frequency range between both drivers in each speaker.

The fully enclosed acoustic suspension cabinets are easily assembled. All you need are normal household tools and a couple of hours and you've built yourself the finest pair of speakers in their class!

D19 TWEETER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20KHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts
(fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
Cat. C10301 .... **$38**

C20 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 35 - 6,000Hz
Resonance Frequency: 39Hz
Sensitivity 1W at 1m: 90dB
Nominal Power: 50 Watts
(12dB/oct)
Voice Coil Diameter: 25mm
Voice Coil Resistance: 5.5 ohms
Moving Mass: 15 grams
Cat. C10322 .... **$89**

Cat. K86092 (speakers only) **$379**
Cat. K86091 (complete kit) ... **$449**

rie

Rod Irving Electronics

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Phone (03) 663 6151

425 High St, NORTHCOTE
Phone (03) 489 8866

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(STRICTLY ORDERS ONLY)

LOCAL ORDERS
& INQUIRIES
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POSTAGE RATES:

$1 – $9.99	$2.00
$10 – $24.99	$3.00
$25 – $49.99	$4.00
$50 – $99.99	$5.00
$100 – $199	$7.50
$200 – $499	$10.00
$500 plus	$12.50

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 1KG!!

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

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56 Renver Rd, Clayton.
Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

*Apple and IBM are registered trade names

MasterCard VISA

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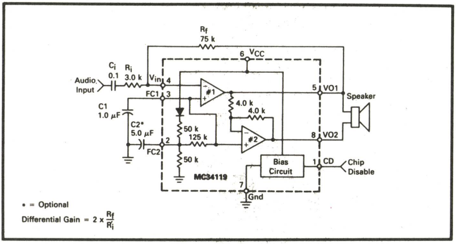
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



* = Optional

Differential Gain = $2 \times \frac{R_f}{R_i}$

Low power audio amp

Motorola has introduced a new low power audio amplifier IC specially suited for telephone applications. The MC34119 provides differential speaker outputs, to maximize output swing at low supply voltages (2 volts minimum) and to obviate the need for a coupling capacitor.

Open loop gain is typically 80dB, permitting the externally controlled closed loop gain to be set to high values with good accuracy. A Chip Disable pin permits powering down the amplifier and muting the output signal.

The MC34119 audio amplifier is available in a standard 8-pin DIP or surface mount package and offers several advantages over other audio amplifiers on the market. The operating quiescent current is 2.7mA typical, 4mA maximum. The power down quiescent current is 65uA and the minimum supply voltage is 2V. The MC34119 is unity gain stable, permits a wide range of speaker loads (8-100 ohms) and offers low total harmonic distortion (0.5% typical).

Although the MC34119 was primarily intended for hands-free telephones (speakerphones), it should also find use in other applications requiring a low power audio amplifier — such as battery operated equipment, portable radios, tape recorders dictating machines and intercoms.

Further information is available from Motorola Sales Offices and distributors.

Plastic/quad flat pack

National Semiconductor has announced an IC package that accommodates devices with up to 244 leads in a very small area.

Known as Plastic Quad Flat Pack (PQFP), the new design has been approved by the United States' Electronic Industry Association/Joint Electron Device Engineering Council (EIA/JEDEC), as an industry-standard package.

PQFP packages are fine-pitched plastic flat packs with gull-wing leads bent outwards from the package body. The leads are on a 25-mil(0.025") centre-to-centre pitch.

Moulded "bumpers" on each corner of the packages protect the leads, allowing the packages to be shipped in tubes or in a tape-and-reel format designed for automated-assembly equipment.

The design is a cross between the plastic flat packs popular in Japan and the tiny globe "bumpered" package originally developed by AT&T.

The PQFP is easily adaptable to high-speed, automated components placement techniques.

The new family has versions with 52, 84, 100, 132, 164, 196 and 244 leads.

National is tooled up for the 132-lead version and has produced working samples containing its SCX6225 CMOS gate array.

8K x 8 RAM

Goldstar Semiconductor has released the GM76C88, a 65,536 bit static random access memory organised as 8,192 words by 8 bits. The devices uses CMOS technology and operates from a single 5 volt supply. Advanced circuit techniques provide both high speed and low power features, with a maximum operating current of 80mA and minimum cycle time of 60ns/70ns/80ns.

The combination of speed optimised circuitry results in a very high speed memory device. Thus the GM76C88 is suitable for use in various microprocessor application systems where high speeds are required. It is offered in a 28-pin DIP package.

For further details contact Penn Central Group, 56 Silverwater Road, Auburn, NSW 2144.

CHMOS 128K EPROM

Intel has introduced a CHMOS 128-kilobit EPROM (erasable, programmable, read-only memory) designed to meet the low power and high performance requirements of CHMOS microprocessor and microcontroller-based systems.

Intel's 27C128, organized 16K by 8, is pin-compatible with earlier HMOS 128-kilobit EPROMs, such as Intel's standard 27128A and 110-nanosecond 27128B. The new 27VC128 is manufactured with Intel's CHMOS II-E (complementary, high performance metal oxide semiconductor) process technology and provides a maximum access time as fast as 150 nanoseconds. It consumes 100 microamps during standby, 30 milliamps when active.

In addition, Intel is offering the 27C128 in three different packaging options to meet a variety of application needs. Customers can choose a standard 28-pin ceramic DIP (dual-in-line package) a 28-pin plastic, OTP (one-time programmable) DIP; or a 32-lead PLCC (plastic leaded chip carrier) for surface-mount capability.

The 27C128 is available in speeds ranging from 150 nanoseconds to 250 nanoseconds, as well as in standard and extended temperature ranges.

In addition, Intel's Quick-Pulse Programming algorithm allows the 27C128 to be programmed in less than 2 seconds — nearly a hundred-fold improvement over programming times of previous algorithms.

For more information contact Total Electronics, 9 Harker Street, Burwood, Victoria, 3125.

Wide variable gain amps

Hewlett Packard has introduced the HAMP-4001 and HAMP-4002 variable-gain controllable amplifiers, first of a new family of wideband amplifier ICs for use in circuits requiring automatic gain control (AGC). They are intended for wideband digital applications and analog applications such as radar and communication systems.

HP's new thin-film hybrid variable gain amplifiers employ proven HP PIN diode and microwave-transistor technologies, in a circuit conveniently packaged in an industry standard TO-8.

These amplifiers provide the designer with a modular solution to system-gain-control requirements, being easily cascaded with other standard amplifiers in a 50 ohm system. The variable-gain amplifiers require only power connections, with the biasing and coupling provided internally.

The HAMP-4001 provides 22dB gain and 30dB gain control, with excellent gain flatness over the frequency range of 2 to 1,250MHz. These flat stable characteristics are maintained over both the gain-control range and the temperature range of –55°C to +85°C.

The HAMP-4002 provides 17dB gain and 29dB gain control over the frequency range of 2 to 1,600MHz, all with gain flatness of 1dB over the same temperature range.

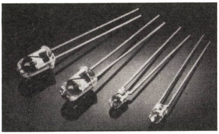
Infra-red LED lamps

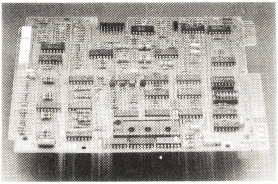
HP has also released a new family of LED lamps that emit infrared light, optimized for maximum efficiency at a peak wavelength of 940 nanometres (nm).

The lamps are available in two package styles, T-1 (HEMT-1001) and T-1 3/4 (HEMT-3301)./ The HEMT-1001/3301 emitters are in untinted, undiffused plastic packages with medium-wide radiation patterns, 60 and 50 degree included angles, respectively. These radiation patterns eliminate beam-focusing problems that may be encountered with more narrowly radiated patterns. Operating temperatures range from –55 to +100°C.

This combination of specifications makes HP's new infrared lamps well suited for optical transducers, optical part counters, smoke detectors, covert identification, paper tape or card readers, and for use in optical encoders.

Further details of both new HP devices are available from the distributor, VSI Electronics, 16 Dickson Avenue, Artarmon NSW 2064.





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Exploring the wonders of

The HP 4951C Protocol Analyser

If you're not too sure exactly what a Protocol Analyser is, and what you'd use one for, you're in good company. An awful lot of engineers and technicians don't know much about them yet, either. This article explains what they are, what they do and how you drive one — they're easier than you'd think.

by JIM ROWE

Protocol Analysers haven't been around for very long, and for much of their short life they've been used mainly in the specialised field of mainframe data communications. As a result, not many people even knew of their existence — let alone what they were used for.

It's only been in the last couple of years, with the explosion in personal computers and data communications, that they've become more widely known and used. But even now, there aren't all that many electronics engineers or technicians who know much about them or have used one.

Even the name itself seems to put many people off, because it gives little idea of the instrument's exact function. What exactly is a protocol, and why do you need to analyse it?

OK then, let's try to explain the mystery. First of all, we're talking about data communications — computers talking to each other and exchanging data, via communications links. Generally this activity will involve gadgets like modems, multiplexers, cables, telephone exchanges and so on. Increasingly nowadays it will also involve microwave and satellite links, optical fibre cables, packet switching networks and nodes, and a multitude of other new technologies.

Also coming into the picture is software, running not only in the computers at the nominal "sending" and "receiving" ends of a data link, but often in many of the gadgets in between. Because many of these are in reality specialised computers, as well.

Now if you've ever tried hooking up a simple data link yourself, like connecting a serial RS-232C terminal or a printer to a personal computer, you'll know that things often don't go smoothly. First of all there's the business of getting the right cables and connectors; then there's the basic electrical connections to get right; then to see if the devices at each end are using the same "handshaking" signals; then to make sure they're set for the same communications rate (i.e., baud or bits per second); then that they're using the same data code (ASCII, Baudot, EBCDIC etc.); then parity and other error checking, and so on and so forth . . .

This rigmarole is bad enough for a simple data link, like hooking up a terminal or a printer. When things don't work (not an uncommon occurrence!), it can often take hours to track down exactly what is going wrong, and fix it.

Now imagine how much more difficult it could get with much more complicated data links, involving "intelligent" modems, multiplexers, packet assemblers and disassemblers, network managers and so on. Get the idea? Without something pretty fantastic in the way of test gear, it would be a nightmare.

Enter the Protocol Analyser, a kind of cross between a scope, a logic analyser and a computer, and designed specially to analyse data communication systems.

But what about "protocol" — where does that come in? Well, remember all of those aspects that you have to check, one by one, when you're trying to find out why your PC won't print out on your new serial printer? Connectors and connections, handshaking, the data code and format, parity, baud rate and so on?

You probably didn't realise it, but in checking each of these you were actually checking out communications protocols. That's because "protocol" is just a fancy name for a standard, or set of conventions, governing some aspect of data communications.

It's becoming common to speak of a hierarchy of data communications protocols, arranged in order of their level of abstraction. The physical level comes first, involving things like connectors, voltage and current levels, things like RS-232C and RS-449 and so on. Next comes the "data link" level, involving data codes, communication rates, handshaking, parity and character error checking, etc.

Then there's the "network" level, involving things like addresses for sender and receiver, assembling the data into packets, checking if packets are correctly received without errors and resending if not, and so on.

In fact the International Standards Organisation (ISO) has defined a total of seven different levels of protocol for data communications, known as the 7-layer Open System Interconnection (OSI) model. As shown in Fig.1, it ranges from the essential physical level (1) right up to the most abstract "application" level (7), where the communication is visualised as taking place transparently between the software running in the computers at each end.

Needless to say, for communication to take place between any of the "higher" levels, things have to be right at all of the lower levels (see Fig.2). So in effect, for data to be communicated between a software program running in one computer at level 7 to another program in another computer (say across the country) at the same level, it has to be "passed down" through the various levels at the sending end, sent over at the physical level, and then must work its way back up up to level 7 at the receiving end — all automatically!

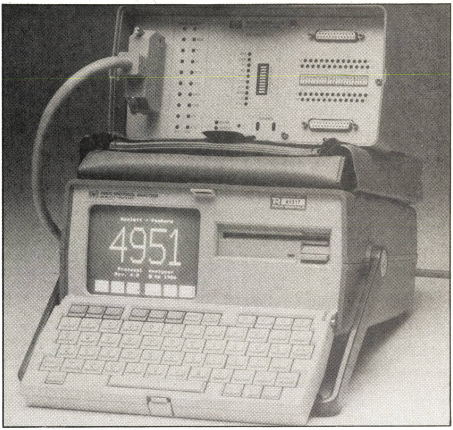
Even this is oversimplifying things quite a bit, because it will quite often move between the lower levels again during the journey, as it passes through modems, multiplexers, packet assembler/disassemblers, and so on.

Hopefully you can now see where the protocol analyser comes into the picture, to let you see what is going on at each of the levels of protocol, and help track down the causes of any problems.

The Hewlett-Packard HP 4951C is a good example of one of the most popular protocol analysers in current use. As you see from the photographs, it looks very much like a portable computer, with its small CRT display screen, flip-down keyboard and built in 3-1/2" microfloppy drive. That's not surprising, I guess, because it really is just a dedicated computer — like so many of today's test instruments.

In fact some of the fancier protocol analysers are essentially very powerful computers, with the equivalent horsepower of about three or four IBM PC-ATs.

The main distinguishing feature of the HP 4951C on the outside is the interface pod, which is used to couple the analyser into the communications circuits you want to examine. There are actually a number of different pods available, each designed to suit different kinds of physical level protocols. Each pod is built into an alternative clip-on lid, which fits over the folded-up keyboard for transport. The pod shown is the one for RS-232C/V.24 protocol, which is the one most often needed by most users. There are others for RS-449/422A/423A and V.35 protocols.



Hewlett-Packard's HP 495IC set up ready for action, with its main menu screen visible. All functions are easily selected using menus and the six function keys just below the screen.

The RS-232C pod shown also includes a "breakout box", to let you play around with the various physical connections in the RS-232C circuit. There are also two sets of LEDs, to indicate basic line conditions.

In use, the HP 4951C can actually perform three different kinds of test:

(1) It can be used like a scope or a logic analyser, to *monitor* the data communications taking place between the devices at each end of a circuit; or

(2) It can be used to *simulate* the device normally connected to either end, sending various kinds of test data messages for you and then showing you the response from the other end; or

(3) It can perform a series of special *bit-error-rate* or BERT tests on the data circuit concerned, using test data signals designed to allow it to measure the

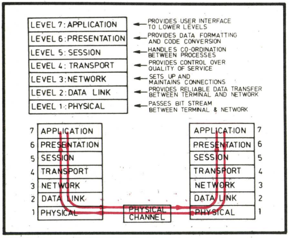
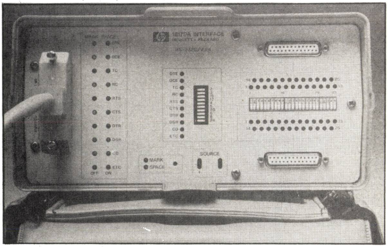
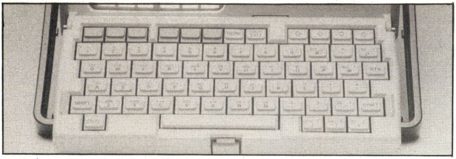

LEVEL 7: APPLICATION
PROVIDES USER INTERFACE TO LOWER LEVELS
LEVEL 6: PRESENTATION
PROVIDES DATA FORMATTING AND CODE CONVERSION
LEVEL 5: SESSION
HANDLES CO-ORDINATION BETWEEN PROCESSES
LEVEL 4: TRANSPORT
PROVIDES CONTROL OVER QUALITY OF SERVICE
LEVEL 3: NETWORK
SETS UP AND MAINTAINS CONNECTIONS
LEVEL 2: DATA LINK
PROVIDES RELIABLE DATA TRANSFER BETWEEN TERMINAL AND NETWORK
LEVEL 1: PHYSICAL
PASSES BIT STREAM BETWEEN TERMINAL & NETWORK
7 APPLICATION
6 PRESENTATION
5 SESSION
4 TRANSPORT
3 NETWORK
2 DATA LINK
1 PHYSICAL
PHYSICAL CHANNEL
APPLICATION 7
PRESENTATION 6
SESSION 5
TRANSPORT 4
NETWORK 3
DATA LINK 2
PHYSICAL 1

Fig.1 (top): The seven protocol levels forming the OSI model for data communication. Fig.2 (above): Data moves down to the physical level for transmission, then back up again.



A close-up of the HP 495IC's interface pod, which includes a "breakout box". The DB-25 connectors at top and bottom right are used to connect to the circuit under test.



A closer look at the HP 495lC's flip-down keyboard. Unlike most computer keyboards, it can be used to generate virtually any data code.

overall quality of the line.

As a data monitor, the analyser is simply connected across the normal communications line. It can then be used to examine the communications taking place, at any of the appropriate levels.

How does it know all of the protocols operating, in order to lock onto the data and show you what is happening? Well, if you already know the protocols (often this is the case), you can simply feed the parameters into its memory — rather like selecting the right ranges on a scope.

With the HP 4951C this is very easy, because virtually all of the instrument's operation is controlled by software menus. So all you have to do is select "setup" mode from the main function menu, and then select the various communication parameters from the menus.

If you don't actually know the protocols that are operating, the analyser will actually work them out for itself, using its built-in intelligence. This is known as Auto Configure, and again you simply select it from the main menu . . .

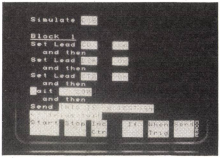
As well as letting you see what is going on in real time, the monitor mode also stores all of the communications data it finds in an internal buffer memory. So you can recall it after the event, and examine it in detail — rather like a storage scope, except that you can "replay" the recording in real time, virtually recreating a whole sequence of events!

If you wish, you can tell the analyser to look for special events, such as particular data bytes, destination addresses, and so on. It can be told to count clock pulses after a certain line changes level, or look for a combination of conditions on the handshaking lines, or whatever. There's great flexibility — and all easily controlled using simple menu selections.

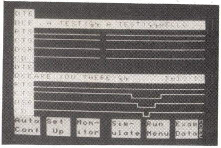
As a simulator, the HP 4951C can be set up to act as almost any kind of data communications device, of either main kind: a Data Communications Equipment (DCE), such as a modem, or a Data Terminal Equipment (DTE), such as a terminal or a computer.

The great feature here is that you can program it to perform in any number of ways, sending out handshaking and data signals in virtually any desired fashion. You can specify the data messages to be sent, how and when it is to be sent out, what to do with incoming data, and so on. And all this is done using simple on-screen menus, which guide you all the way. It's surprisingly easy.

Then when you've set up a program to perform the simulation you want, you simply tell it to run, and it springs into action. As the program is running, the screen shows you exactly what is happening — very much like a logic analyser. You see the signal levels on the handshaking lines, plus the data codes on the main signal lines (see screen photos). And of course, everything is also being stored away in the memory, to allow you to analyse it at your leisure later.



Above: Setting up a program for simulation is quite easy — you are guided all the way by menus which redefine the six function keys. Below: When a simulation program is running, the screen shows you handshaking signal levels as well as the data on the main signal lines.



For BERT testing, the HP 4951C can be set up for either one-way tests with an analyser at each end, or for up-and-back testing using a single analyser at one end. In the latter case, the communications circuit must be looped-back at the far end.

Incidentally the HP 4951C has a non-volatile memory, so its setup data, simulation programs and test data are all retained in memory when the power is turned off. This makes it very convenient for field testing.

So that I could find out for myself how easy the HP 4951C is to drive, EA was loaned the unit shown in the photos by Tech-Rentals, the equipment rental company. Although I've never actually driven a protocol analyser before, I found it very easy to use — thanks to the logical menu driven operation. After only a couple of hours I found myself setting it up quite confidently for simulating a modem, and sending test messages to my IBM PC running a communications program.

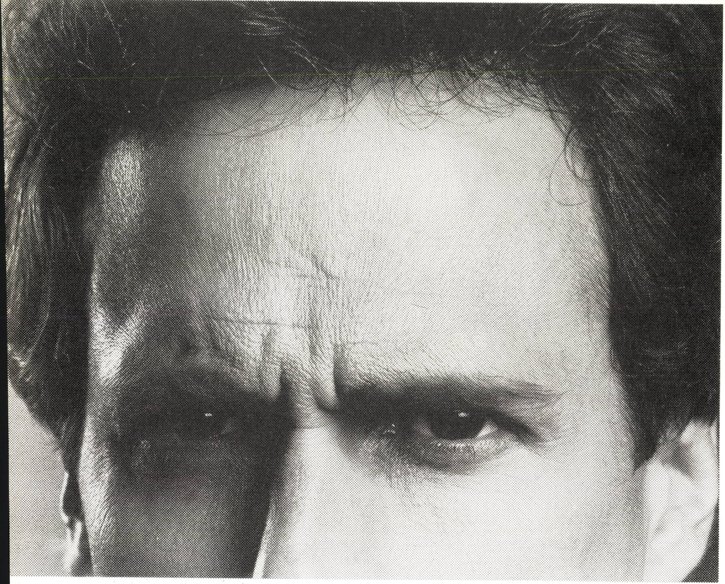
Actually I did have a bit of trouble getting the IBM to respond — not because there was any problem driving the HP 4951C, but because I couldn't remember how to configure the IBM comms program!

I found the flexibility of the HP 4951C very impressive. It's so easy to vary virtually any parameter you fancy — baud rate, handshaking signal timing, test message content, the data code used — you name it! It's all under your control, by keying in a few simple commands.

Even from this short test drive, you get a much clearer idea of just how powerful a tool the protocol analyser is for tracking down problems in data communications systems. In fact as we go further and further into the data communications era, I can see these instruments becoming virtually essential for any kind of efficient troubleshooting.

If you need one just to help you sort out a few curly problems, the Tech-Rentals people have them for rent by the day. They have offices in each state, where you can get catalogs and further details.

Needless to say, firms like Hewlett-Packard are also able to sell you one, if you have a more ongoing need. The model HP 4951C currently sells for around $8000. Hewlett-Packard also has offices in each state.



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New Products

Oxygen/temperature meter

TPS has just released an improved version of the LC-82 portable oxygen/-temperature meter. The LC-82 is a hand-held instrument with an LCD for ease of use in field applications. Read-out of oxygen is in either parts per million or % saturation units. Temperature is provided to 0.1°C.

Temperature compensation for oxygen values is fully automatic. A recorder socket provides an output signal for chart recorders.

The oxygen electrode has also been re-designed and improved. It is now more robust and all-plastic construction, with a membrane protector.

The meter features extremely low battery drain. In normal use, battery life is about one year.

For more details contact TPS, 4 Jamberoo Street, Springwood, Brisbane 4127.

Australian developed disk controller

An ESDI controller card which enables the high-speed ESDI (Enhanced Small Device Interface) Winchester type drives used on many mini computers to be connected to PC's has been released by Pulsar Electronics.

According to the company it is one of only two known in the world and has twice the specifications of the other, US designed, product.

According to Pulsar, using ESDI drives with PC's can eliminate many of the problems and restrictions on large Local Area Networks (LAN). The drives also enable PC's for the first time to carry and service database files as large as 1000 Megabytes under the MS-DOS operating system without the need for special drivers.

For further information contact Pulsar Electronics, Lot 21 Catalina Drive, Tullamarine 3043.

Ceramic chip capacitors

Specifically designed for high-voltage stress conditions, the type 12C high-voltage monolythic ceramic chip capacitors manufactured by Sprague Electric are intended for mounting on printed wiring boards or hybrid circuit boards in UHF bypass, coupling, servo and similar military and commercial applications.

They are available in 500V to 2500V DC ratings in standard capacitances up to 220,000pF. They are manufactured in X7R and COG formulations.

Manufactured by the same processes used in the construction of the company's monolythic capacitors, these leadless unencapsulated multilayer chip-style capacitors with metallized terminations can be used in thick-film hybrid micro-circuits and printed wiring boards. Chip-style capacitors can be attached to microcircuit substrates by reflow solder techniques, by conductive epoxies and by semiconductor techniques such as thermal compression bonding.

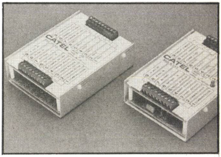
For further details, contact Sprague Electric Division, 56 Silverwater Road, Auburn 2144.

Regulated power supply

Imark has released the Australian-designed and manufactured Imark PS-4 regulated power supply for use with CB transceivers, amateur transceivers, security systems, car cassette/radio players or as a bench power supply.

The PS-4 operates from the 240V mains supply and provides 4A of regulated 13.8V DC. It features all solid state circuitry with short-circuit and overload protection.

Further details can be obtained from Imark, 167 Roden Street, West Melbourne 3003.



Module for multiplex control

The new Catel MS-300 series of multiplex remote control and signalling modules released by Sam Technology transmit digital or contact closure signals over twisted pair, coaxial cables, optical fibres, phone circuits, microwave or IR.

They are suitable for extending control lines, providing remote signalling and alarm inputs and sending data gathered remotely to a central monitoring system.

Up to six data points can be handled by each MS-300 transmitter or receiver. Transmitters and receivers are available in four different bands (2800, 1650, 980 and 580Hz) so that up to 24 data points can be transmitted in FDM format over one voice circuit.

No master control is needed for multi-point operation. Output from the receivers can be transistor, triac or reed relay.

The module's standard external supply is 16V AC.

Sam Technology welcomes enquiries at 36 Binney Road, Marayong, 2148.

Laser printers

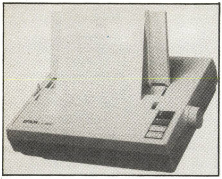
The Impact L1500-01 is a 15 pages per minute laser printer with a paper jogger that keeps individual jobs separate — delivered collated face down.

The dual input bins handle 250 sheets each.

The L1500-02 contains the capabilities of the L1500-01 with the PostScrip page description software.

PostScript allows the user to rotate scale, translate, draw lines and arcs shade, and precisely position text and graphics.

More details are available from Impact Systems, 7 Gibbes Street, Chatswood 2067.



New generation printer

Epson has introduced its LX-800 printer to Australia, which Epson says, prints at 180cps in draft elite and 150cps in draft pica. A feature of this economical printer is an enlarged 3Kb print buffer.

The printer's SelecType front control panel allows auto single sheet loading.

In addition to roman, sans serif is now included in resident fonts.

According to Epson the new ribbon cartridge prints 3 million characters, three times more than the company's previous models.

The LX-800 offers download character capability of 6 characters; and elite, italic and super- and sub-scripts are supported in both draft and near letter quality modes.

For more information contact Epson Australia, 3/17 Rodborough Road, Frenchs Forest 2086.

Software analyses intermodulation problems

To help solve the problems that can occur due to intermodulation distortion when signals from various transmitters of different frequencies mix with each other, Radio Frequency Systems of Kilsyth, Victoria, (formerly Antenna Engineering Australia) has developed a computer program that can analyse the effect of up to 100 different transmitters on up to 100 different receivers.

The hard copy printout defines signal frequencies that may cause problems to the receiver. With this information the necessary precautions in form of bandstop or bandpass filtering can be taken.

RFS will supply this analysing service at a nominal low fee to customers or others interested. The company can then also supply the necessary filtering networks.

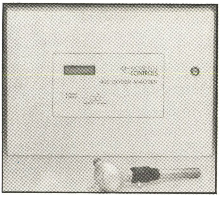
For more information contact Radio Frequency Systems, PO Box 191, Croydon 3136.

Combustion controller is self calibrating

A new Australian developed oxygen analyser-controller for combustion monitoring and control employs a novel design which allows the sensor probe and analyser to be self calibrating, according to its supplier Novatech.

This eliminates the need to regularly check and recalibrate, a problem common to most existing oxygen probe/analyser systems.

The analyser electronics self calibrates all analog input sections every two seconds. If the analyser is unable to self calibrate, there will be an alarm. The analog output sections of the analyser are also checked every 2 seconds. If any calibration drift occurs, an alarm will alert the operator, to perform a calibration. This is a press button function which takes 2 seconds.



The probe also has an automatic online calibration facility, where a known gas from a pre-tested cylinder is automatically admitted to the probe sensor under control of the analyser microprocessor. If an error beyond a nominated level occurs an alarm will again be initiated. Alarms are identified by the operator in plain English on an LCD display.

For further information contact Novatech Controls (Aust), 429 Graham Street, Port Melbourne 3207.

Benchtop board tester

Marconi Instruments is marketing a benchtop automatic board test system, called Checkmate, designed to meet the needs of production, design, research and educational establishments.

Its functions are determined by plug-in cards. It can work as a digital or analog tester or both.

Test options range from in-circuit to logic analysis.

Checkmate requires no specialist programming skills.

More information is available from Marconi Instruments, 2 Giffnock Avenue, North Ryde, 2113.

Speech workstation from Intel

Intel Corporation has introduced a second generation factory speech workstation, the iSWS 210. The unit provides hands-free, eyes-free, voice-data entry in a variety of real-time industrial and laboratory applications.

The new speech workstation can recognise 1,000 words (an increase of 800 words over its previous system) and is built to withstand temperatures up to 55°C in industry and dirty environments. It can also discriminate between background factory noises and the human voice.

Besides voice data entry, the workstation synthesizes speech from text and can be used to verbally communicate with the operator. With the iSWS 210 the ability to "speak" to the operator through an earphone obviates the need to look at a screen.

The new workstation is housed in a 19" rack mount cabinet, and has three removable media options: a magnetic bubble cassette, a 3.5" microfloppy disk, or a 5.25" minifloppy disk.

Data is entered directly into the system by speaking commands into the microphone. To accommodate the natural changes in speech, the system features "adaptive training".

If the system has not recognised a word or phrase with certainty, the system prompts the operator to verify the word or phrase. The operator verifies the word with a "yes" or "no" command. The speech workstation uses the confirmation data to modify its reference template for how specific words appear to it when the operator voices them.

For more information contact Intel Australia, 200 Pacific Highway, Crows Nest 2065.

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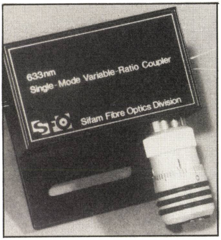

633nm
Single-Mode Variable-Ratio Coupler
Sifam Fibre Optics Division

Variable ratio FO coupler

A single-mode, variable-ratio coupler for fibre optics has been developed by the fibre optics division of Sifam.

The evanescent wave coupler can be supplied for operating wavelengths of 633, 820, 1300 and 1550nm and allows the coupled power to be adjusted to any value in the range of 0 to 80%. Tuning is carried out through a micrometer adjuster.

Designed primarily for research projects, it is said to be particularly suitable for use where fine tuning of the split ratio is required — for example in fibre ring resonators. Excess loss is claimed to be less than 0.5dB, with directivity better than –50dB, over the operating range.

Built into a sturdy aluminium-alloy case with a mounting flange, the device has an operating temperature range of 15°C to 30°C, though it may be stored in temperatures from –5°C to +50°C.

In August 1986 Sifam announced its entry into the fibre optics field and the manufacture of a range of standard single-mode components such as fused couplers, splitters and ladder couplers.

The variable-ratio coupler is the latest development from the "teaching company" partnership established by Sifam with Strathclyde University in the UK.

For further information contact C & K Electronics (Aust), 55 High Street, Harris Street, Harris Park 2150.

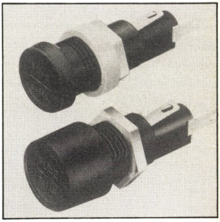
AM transmitters

A range of all solid state AM transmitters covering the range 70W to 1kW, wholly designed and manufactured in Australia, and are now available through Radio Manufacturing Engineers.

Designed by Ian Hill and Associates, all transmitters are supplied as 19" rack mounted units and 19" cabinets can be supplied as an option.

Some of the other features include overtemperature, VSWR and overvoltage protection, AM stereo input, all routine adjustments via the front panel, main plug in PC boards and remote or local operation with status memory. They also have a fault memory after mains fail.

Further information is available from Radio Manufacturing Engineers, Unit A, 30-32 Skarratt Street, Auburn 2144.



Panel mounting fuseholders

Sifam has introduced a new range of panel-mounting fuseholders. The advanced design is a new addition to the existing range of panel components, and is aimed at complementing the styling and finish of meters, knobs and pushbuttons manufactured by Sifam. The design conforms in every respect to establish fuseholder practice for fitting and performance.

There are two basic types, with low or high front-of-panel profile to suit requirements for minimum projection at the front or at the rear. Both types are available for "d" hole or keyed hole-mounting and can accommodate a pane thickness from 0.5 to 5.0mm (4.5mm with sealing).

Moulded in high grade glass-fille polyester for the base and nylon for the carrier, with a finely-textured mat black finish, the fuseholders are rate up to 10A/250V. They are SEMKO ap proved and comply with IEC 257 for a x 20mm fuses, and are touch and finge

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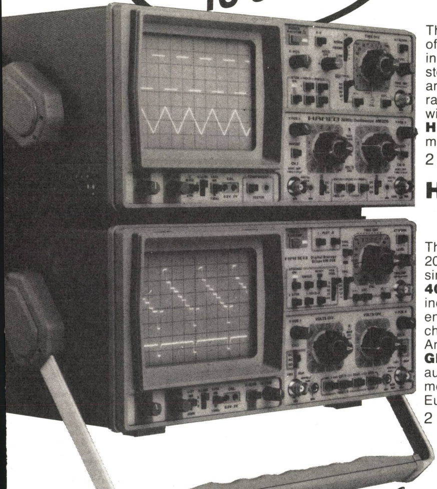

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This new oscilloscope offers all the features of a state-of-the-art **20MHz** realtime instrument. In addition it provides digital storage capability for signals between **50s** and **0.3ms** duration, with a max. sampling rate of **5MHz.** Especially when working with comparatively slow phenomenae, the **HM205** can easily replace considerably more expensive digital storage scopes.

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HM208

the high tech Storage Scope with 20MHz sampling rate

The **HM208**'s high sampling rate of max. 20MHz facilitates storing of relatively fast single shot events. Max. memory is **4096 × 8** bit, conveniently divided into two independent blocks. **XY-storage** capability enables easy viewing and recording of characteristic curves and Lissajous figures. An XY-recorder output and the optional **GPIB-Interface** allow full integration in automatic measurement systems. With more than **5000** units sold, this is one of Europe's best selling digital storage scopes.

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proof to BS3042 to give maximum protection against electric shock from the front. The fuse carrier is screwdriver-slotted for easy withdrawal.

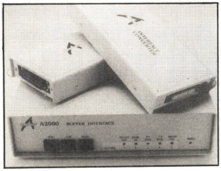
Silver-plated brass terminations can be soldered or well accepted standard 2.8mm push-on connectors. The standard configuration for the live terminal is "in line" but can be supplied as radial.

For further information contact C & K Electronics (Aust), 55 High Street, Harris Park 2150.

Buffered interface

An advanced new buffered interface system, the A2000, has been announced by Alfatron. Primarily aimed at the PC market, is said to provide an answer to many problems experienced by users of computer systems in office environments.

Designed and manufactured in Australia, the buffer can provide up to six serial and two parallel channels to interconnect computers and peripherals. Its simplest implementation is as a printer sharer unit, and it offers buffer sizes from 256K bytes up to 1M byte.



Through the use of easily generated escape sequences, any port may be routed to any other port. In this mode it can allow computers to talk to each other, or allow multiple peripherals to be accessed without any physical switching or re-cabling.

Serial channels operate fully bidirectionally and parallel channels can be configured in either direction by means of DIP switch settings. The serial channels will run at speeds up to 38.4k baud and all paths established through the unit are simultaneously buffered.

For further information a data sheet is available from Alfatron, 1761 Ferntree Gully Road, Ferntree Gully 3156.

Intelligent data switches

NetCommander is a range of inexpensive, intelligent data switches, now available from Data Bridge Electronic Communications. One of the switches allows a group of PC users to share one or more printers and up to 30 devices can be made to communicate simultaneously.

The switch continually monitors the serial output port of each PC. When it detects activity, it automatically routes the data to the location specified in the leading bits of the transmission.

The switch can also be connected to a LAN (local area network) node, providing the full resources of the LAN to any device linked to it.

The wiring medium can be RS-232C cable or twisted pair wire and transmission speeds range from 300bps up to 19.2kbps.

Multiple protocols and data transmission speeds are handled by the Netcommander which has a hardware buffer of up to 1Mb.

Further information is available from Data Bridge Electronic Communications, 604 North Road, Ormond 3204.

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MHL 4026

Continued from page 65

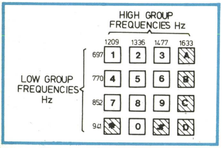


Fig.3: Many modern electronic phones and attachments use dual-tone multifrequency (DTMF) dialling, rather than the older and slower pulse dialling. Here are the frequency pairs used for each digit.

make and break method of signalling; instead they generate tone-pairs, each of which correspond to one of 16 codes.

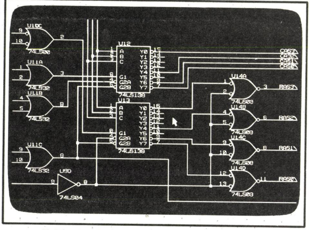
Tone signalling is more convenient and more efficient than the old methods. It offers higher reliability and has uses outside the basic switching function — in answering machines, radio communications, data transmission and emote control.

With DTMF the telephone handset generates a composite audio signal, nade up by superimposing two tones elected by a line-and-column addressng of a keyboard. (See Fig.3). The ourth column of buttons using the 633Hz tone is not found on most of oday's touch-phones, but it has been et aside for future signalling use.

The DTMF frequencies were chosen o that neither harmonics or intermoduation products would fall in any one of he tone bands. You get about 10% eparation between tones. The tones are ent over the lines to the exchange, here decoder circuitry converts the TMF signal to a binary format. For ne traditional dial-pulse equipment, a rther conversion takes place in a tone-pulse converter.

DTMF technology lends itself to a ariety of remote-control applications, cluding those using radio-telephone ages. Tone signalling allows radio nks to plug-in transparently to the telehone network.

Remote data entry is also possible, as e automatic credit-card verification stems, home banking and shopping. oupled with voice synthesis techques, DTMF brings many of the adntages of ATMs and point-of-sale uipment directly into the home witht adding subscriber equipment. One n only wonder why we haven't all en using them for years.



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Letters

Cont. from page 5

rect connection is not available across the battery terminals and/or operation is required in a moving vehicle.

Setting output RMS voltage: Output RMS voltage may be set using an average reading AC rectifier meter. When the average reading meter registers 255 volts, the output RMS value will be close to 230 volts. This occurs because the form factor for the output waveform is close to 1.0 while the form calibration factor for an average reading rectifier instrument is 1.11. This method is midway in accuracy between the true RMS meter and the light bulb comparison methods, but far more convenient than the latter.

The additions described above enhance the versatility of the inverter without detracting in any way from its performance.

R. Beaumont,
Pennant Hills, NSW.

Comment: Thanks for the information Mr Beaumont. I'm sure other builders of this project will find it of great interest.

NiCad batteries

I am very concerned about the Dick Smith Electronics advertisement for the NiCad cells, which appeared on page 78 of the June EA, and again in the company's insert in the July issue. The text contains statements and draws conclusions which are at variance with well known facts about these cells. I enclose copies of technical articles on NiCads which have appeared in EA, ETI and other publications, and have highlighted relevant portions.

It appears to me from studying the advertisement and a conversation I had with its author that he is not well informed on the subject of batteries and their applications.

Firstly, I consider the text of the ad to be very vague (e.g., figures are quoted without reference to cell type, size or brand). However, the general thrust is obvious and might be summarised as . . . "replace the dry batteries in your portable electronic equipment with NiCads and enjoy large savings in cost, improvements in performance and longer running time per charge than before." There are many well known problems with this proposition, making it doubtful advice at best. Taking the four paragraphs in order the objections are:

1. Four hundred plus charges *might* be obtained, but only under laboratory controlled test conditions. Series discharge of unmatched cells and recharge before complete discharge will severely limit the life of a cell. This high cost of changeover to NiCads ($50 to $300 including charger/s) means a break-even point of about 50 to 100 cycles. In many cases this may not be reached, due to cells deteriorating. Also many users will find waiting 12 to 14 hours before reuse very inconvenient, necessitating purchase of a second set of cells so as to have a charged set on hand. More cost, hence longer to the break-even point.

2. The constant discharge voltage of a NiCad is not disputed and may be good in a few applications, BUT the *normal* terminal voltage of only 1.2 volts is very close (within 0.1 volt) to the *end* point voltage of a dry cell. Your torch or cassette player will perform as if it had nearly flat dry cells in it. Some equipment will barely work at the reduced voltage offered by NiCads.

3. The internal resistance of a NiCad is very low, allowing high discharge currents — sometimes dangerously high if the equipment was not designed for them. Stalled motors in toys can be burnt out, flash units may overheat and fail. (See National flash unit operating instructions). Accidental fires are likely if shorts occur inside equipment or to cells. A "C" size NiCad can deliver 100 amps plus if shorted.

4. The energy capacity (amp hours) of a NiCad is superior only to the poorest grade of dry cells. The figures in the Plessey brochure (quoted as a source by DSE) were obtained by comparing a NiCad with a light duty dry cell, in a heavy duty situation. Arguing from a single example is logically erroneous.

I performed a 90mA discharge test on Eveready "Red" cells (as sold in Dick Smith stores) and found they lasted over 5 hours to 1.1 volts. The specifications for Eveready "Black" and Alkaline cells indicate 10 hours or more is to be expected. ANYONE considering investing in NiCads would have to be using their equipment regularly and heavily, and would be most unlikely to be using light duty dry cells. The example given in the ad is not typical, not explained (what dry cell?) and is therefore misleading.

There is a further misleading assertion in the text accompanying the "Multi-Cell Charger", where it is claimed one can "properly" check a NiCad cell by measuring its voltage under load. This is nonsense. The paragraph 2 statement about constant voltage discharge means that the state of charge CANNOT be found by measuring the voltage under load. It is likely that users of this device will believe cells to be fully charged when they are not, and/or to overcharge only partly discharged cells. Either of these errors will shorten the life of a NiCad cell.

A charger design which overcomes this difficulty appeared in *Electronics Australia* in March this year.

I would hope that some form of correction or retraction appears shortly.

Phil Allison,
Sydney, NSW.

Books

Continued from page 84

because of the difficulty in obtaining it elsewhere.

The author Richard Miller is apparently widely recognised in the USA as an expert in the fields of artificial intelligence, computer-aided engineering and robotics. He has published quite a few other books on these subjects, and has acted as consultant to over 250 companies. He has also made pioneering contributions in the field of CAE, including an algorithm for electro-acoustic transducer design.

In this book he has produced a practical manual for use by manufacturing engineers and engineers, covering the use of robots in many different applications. These include metal fabrication, electronics manufacturing, plastics, food processing, health care, textiles, printing and packaging. There's a wealth of information given, although most of it seems to consist of illustrative examples of existing installations and applications rather than design details.

Fairly obviously the artwork for th book itself has been produced using word processor — no doubt to sav time and keep it as timely as possible This is fair enough, but to be honest i could have done with a bit more proo reading; there are quite a few typo's i places. Some of the illustrations leave lot to be desired, too — giving ever appearance of being reproduced fror rather poor photocopies. Not too im pressive in a book of this very signif cant cost.

On the whole, I suspect that the pe ple in manufacturing concerns for whor it's mainly been written will find it o great interest and value, despite thes limitations. But it will have limited a peal to others.

The review copy came from distrib tors Prentice-Hall of Australia, who a vise that it is available from major tec nical bookstores. (J.R.)

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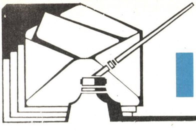


Information centre

HF transceiver

I have been a reader of your admirable magazine since the *Wireless Weekly* days, and I have made up many of the projects without serious problems. But recently I tackled your HF transceiver (October 1985) and found one that stumped me.

I wonder if there might be some errata still to come. Take Q18, for example, the voltage table indicates 9 Volts on the collector, but it derives its potential from an 8 Volt rail! Also the bias should be 0.8V, but the bias resistors are 180k and 10k. (I have changed the 180k for a 150k, did I do wrong?)

Also Q32: the table shows 5.0V on the emitter; my measurement is 0.4V (Battery 12.78V).

But this is the one the Serviceman might appreciate. The Q5 and 6 drivers and the Q7 and 8 power amplifiers have 12.78V on the collectors, and 0.82V on the bases, but the quiescent current for the drivers is only 23mA (it should be 50mA), and only 34mA for the PA (it should be 100mA). A thorough check has been made of the circuit and the transistors have been checked with an ohmmeter. No decrease in the Vcc can be noticed when the transmitter is energised. All seems to be operating normally in the receiver and in the transmitter up to and including the RF predrivers. (Fr. A.T., Vanimo, PGN).

- ***This design originated from Dick Smith Electronics, as you probably realise, and we can only offer limited help. You noted that Q18 derives its collector voltage from a 8V rail, although the voltage table indicates 9V. You are right, of course; this is not possible. However, on page 11 of the kit manual, you will see that the supply voltage is specified as 8.00 — 9.00V. The voltage table is based on a 9.00V supply, and not on 8.00V.***

With regard to the values of the bias resistors for Q18, it might help to know that the 10k and 180k are not the original values as published in EA. These were 10k and 82k. From your findings, we expect that 180k is too high, and your 150k gets closer to what it should be. You could even try 120k or 100k.

The voltage table shows for Q32 an emitter voltage of 5.00V and a base voltage of 1.0V. This must be wrong: if the emitter voltage is higher than the base voltage, then the transistor would not conduct. Your measurement of 0.4V makes a lot more sense, so perhaps the original should have read 0.5V.

As far as the difference in the quiescent current of the drivers and the power amplifier is concerned, we don't think the circuit diagram is wrong. The differences in current are not likely to influence the performance of the transmitter significantly.

Electronic Wattmeter

I am having trouble with the Electronic Wattmeter, of September 1983. Are there any alterations or errata to the circuit?

With 1.5V on TP3 to TP2, VR3 has no effect on zeroing the meter but VR1 does zero the meter. There is a + or — drift from meter zero. With 1.5V on TP3 to TP1, VR1 has no effect on zeroing the meter but VR3 does zero the meter, with greater zero stability than from TP2.

With the connections as Fig.2, VR4 has no effect on the adjustment of the meter to 3kW. There is a –2.15V on the positive terminal of the meter and adjusting VR4 has no effect on the –2.15V. My positive supply is 12.16V, while the negative supply is 11.52V. (A.W., Elwood, Vic.)

- ***There has indeed been some errata on this project. The text should say "with 1.5V between TP3 and TP2, adjust VR1 for zero. With 1.5V between TP1 and TP3, adjust VR3 for zero." Note also that point 9 on the PCB overlay goes to the negative meter terminal.***

"Screecher" car alarm

In the Screecher Car Alarm, of August 1986, where do the wires from the terminal block of this project connect to, in the car? I'm having difficulty working this out. (C.Mc.G., Avondale Heights, Vic.)

- ***To wire the Screecher Burglar Alarm to your car, first find the writing on the printed circuit board next to the terminal block. The connections are as follows:***

V+ connects to the +12Volts (fuse box or battery positive);

gr connects to the body of the car or the negative battery terminal;

S- connects to one of the speaker wires and S+ to the other. The 100μF capacitor is also connected here (see article);

i2 connects to a normally low (no voltage) sensor switch which goes high (12 volts) to trigger the alarm;

i1 connects to a normally high (12 volts) sensor switch which goes low (0 volts) to trigger the alarm (e.g. door switch side of courtesy lamp).

Low distortion oscillator

I have recently built (from an Altronics kit) the Ultra Low Distortion Oscillator as described in EA, Decembe 1986 — January 1987. Although it was simple matter to adjust all frequencie for equal output level, I found the jo of adjusting each frequency range s that the frequency scale calibrations ar correct to be impossible.

On feeding the output of the oscillator into the EA 7-digit 500MHz Frequency Meter and adjusting the trim pots VR1 to VR4 so that the frequencies for each range were correct at th "100" position on the scale, I foun that all other frequencies were crowde from both ends of the scale towards position centred between the 20 and 2 positions. After adding 470Ω resistor in series with the 150k resistors acros both sections of VR5, I was able to ge correct scale alignment at the centre the pot's travel — that is at the 18 pos tion. At the 10 position, with the rang switch set to the x1 position, the fr quency meter read 11.4Hz and r mained at this frequency until the p was moved above the 11 position fro where the frequency began to increas to the 12 position where it was correc From here up to the 18 position the was a gradual crowding of frequencies.

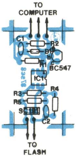
At the high end of the scale th crowding was more severe, so that the 50 position the frequency met read 97.8Hz. From there down to th 100 position the frequency only alte by 2.2Hz. From the 50 position to th

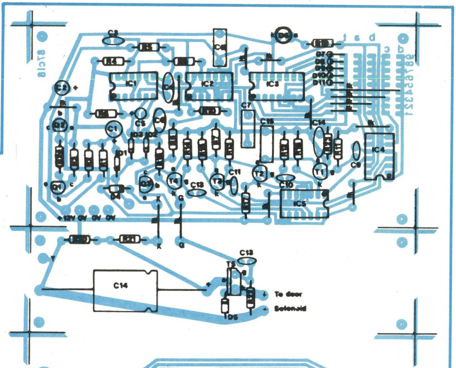
Notes & Errata

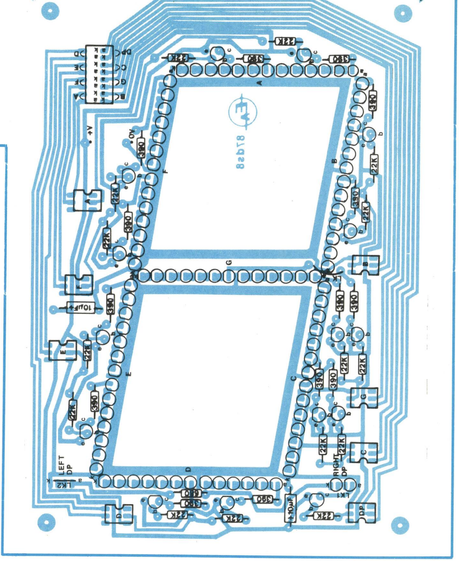
ESTIMATING NOISE IN OP AMP STAGES (April 1987): There is an error in the errata published in May 1987. The formula quoted should read:

$$En = \sqrt{4.K.T.B.R} \text{ or}$$
$$En^2 = 4.K.T.B.R$$

AUGUST 1987 ISSUE — All PCB overlay diagrams for projects: Due to a printing "gremlin", all three overlay diagrams in this issue were incorrectly reproduced and almost unreadable. To assist people constructing these projects, we reproduce all three diagrams again here. Our apologies for the error.







18 position the crowding gradually dimi-shes.

These discrepancies are the same on all ranges (x1, x10, x100, x1000).

I tried changing the dual ganged 50k inear pot to no avail. I also transposed C1 and IC2 for IC3 and IC4, thinking hat one of the integrator IC's may have been faulty. This also proved fruit-ess. Could you suggest a possible cure for this problem, other than the con-truction of another scale. (N.V. Kirra-wee, NSW.)

Your problems with the Low Distortion Oscillator appear to be unique to your kit, for we have had o other correspondence of this ature. One would expect small racking errors between various otentiometer manufacturers, but othing like the extent of your roblems.

An integrator (or capacitor) ehaving in a non-linear manner is xtremely unlikely, therefore the requency scaling is dependent on

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the variable resistance. It sounds like the ganged pot(s) you have used are not what they seem. We would suggest disconnecting the pot and checking the linearity of both halves with a multimeter. If the operation seems suspicious try acquiring one from a different source.

If the pot checks out OK, have a careful inspection of the whole integrator phase shifting network. But we're most suspicious of that pot!

Playmaster 60/60

I have a problem with setting the quiescent current in the left channel of the Playmaster 60/60 amplifier kit, which I purchased from Jaycar last year. The quiescent current in the right channel can be set satisfactorily.

The ±50V and ±15V power supply was perfect, and when the 560Ω resistors were installed in place of the fuses in the left channel, the voltage across these resistors could be adjusted up to about 9V. But after any further adjustment of VR1 the voltage began to oscillate violently. In time the mean voltage across these resistors would creep upwards.

I cannot find any short circuit between collector and emitter, or any short to heatsink on Q13 — Q16. The 560Ω resistor in the left channel does become warm.

In experimenting with this problem I have swapped Q9, 10, 11, 12, 13, 15 between channels, but I still cannot set the left channel quiescent current.

The only difference after these changes is that when the 560Ω resistors are installed across the fuses in the left channel, the voltage across this resistor can be adjusted to 5-9V, and then it goes to 50V with a minute further adjustment of VR1. This happens when the set is relatively cold.

Also with VR1 in the left channel set fully anticlockwise, the voltage across the 560Ω resistor slowly increases up to 5-9V, and then shoots to 50V. This occurs over about 10 to 15 minutes with VR1 still in the full anticlockwise position.

Other differences I have noted are that the 8.2kΩ resistor in parallel with the 0.012 capacitor in the collector circuit of Q10 gets very warm. The voltage across it is 65V and the resistor has developed a brown mark, as though it is overheating. This occurs in both channels. Checking the resistor while in circuit indicates it has the correct value.

Also I am confused about the orientation of some of the transistors depicted in the circuit diagram. For transistors Q9, 10 and 11 the diagram shows a round hole in the face of the transistor with ECB written under the three legs left to right.

I understand this to mean that when you look at the transistor and you see a round hole in the face of it, then the right hand terminal is the base. When checking this by a low ohm resistance scale measuring between the base and the emitter or collector, I believe you should get either a high or low resistance reading at both emitter and collector terminals, depending on the polarity of the base lead. This does not happen with the above orientation. It only occurs if you interpret the terminals as being BCE left to right.

The transistors Q9, 10, 11 supplied with my kit have a round hole in a shiny metallic insert on one side, and the hole on the other side opens into a three leafed clover arrangement, with three round indents outside this hole. I have installed these transistors as BCE left to right when looking at the round hole in the shiny insert. If this is wrong, I have been consistently wrong in both channels, and therefore why will only the right channel work.

I have checked solder tracks and that components are in the right place.

Can you please offer some advice on what I should check next. (I.S., Concord NSW)

• ***From your letter it sounds as i your amplifier is suffering from thermal instability and/or supersonic oscillation.***

The Playmaster 60/60 follow-up article in EA May 1987 may help in tracking down the cause. Reprints o this are available from our office at cost of $4.

When measuring the voltage of B- junctions around the circuit, the quiescent current (voltage across the 560Ω resistor) should not change This effect may be due to a fault multimeter (unlikely) or perhap again supersonic oscillation.

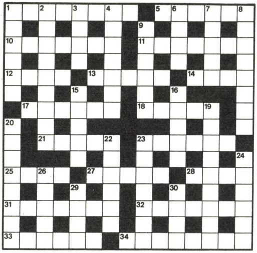
Finding transistor orientation i helped with the following rule. The are shown from the bottom (MJ1500 etc), or looking from the front (BF47 etc). The front being the plastic fac with the identification numbers. seems you have them the corre way around.

Finally, recheck your componen orientation paying particula attention to the diode polarities. Yo may also find the other voltage shown on the circuit some help i leading you to the faulty area.

SEPTEMBER CROSSWORD

ACROSS

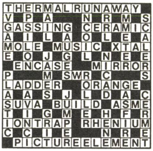
1. OTH radar system. (8)
5. Groups of three bits. (6)
10. Detecting data. (7)
11. Unit of brightness. (7)
12. Uncomfortable perceived stimulus. (4)
13. Well-known brand name in amateur radio equipment. (5)
14. Source of multiband radiation. (4)
17. Contrived gadget. (6)
18. Best position for ship-to-ship communication! (5)
21. These are used in some relays. (5)
23. Outcome of battery? (6)
25. Part of old diode detector, the —— whisker. (4)
27. Applied signal. (5)
28. Scottish-born inventor of telephony. (4)
31. Pre-metric absolute temperature scale. (7)
32. Private telephone connection. (3,4)
33. Unit within a system. (6)
34. Send a signal. (8)



DOWN

1. First name of famous scientist Henry. (6)
2. Term describing function of certain amplifiers, etc. (3-6)
3. An electrolyte. (4)
4. Removal of metal in pattern formation. (7)
6. These memories give equal entry times. (4)
7. Warn, as with an alarm. (5)
8. Apply maximum magnetisation, etc. (8)
9. Type of amplifier with a very linear output. (5,1)
15. Picture element. (5)
16. Substance such as that with symbol Yb. (5)
19. Property due to electron behaviour. (9)
20. Range of wavelengths. (8)
22. Transmitting device. (6)
23. This seems a rather contrary adding device. (7)
24. First name of physicist who first explained the photoelectric effect. (6)
25. Adjusted to optimum. (5)
29. Word of some prominence in the ABC's high-level language! (4)
30. Element used in lamps. (40)

SOLUTION FOR AUGUST



T	H	E	R	M	A	L	R	U	N	A	W	A	Y	
V		P		A				N		R		M		S
G	A	S	S	I	N	G		C	E	R	A	M	I	C
A		I		L		A		O		L		E		A
M	O	L	E		M	U	S	I	C		X	T	A	L
E		O		J		G		L		N		E		E
	E	N	C	A	S	E			M	I	R	R	O	R
P				M		S	W	R		C				S
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A		A		S		J		L		D		A		C
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I	O	N	T	R	A	P		R	H	E	N	I	U	M
C		C		I		E				N		R		E
	P	I	C	T	U	R	E	E	L	E	M	E	N	T

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"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly 3d

September 1937

Radio for motor cars: An increasing number of motor cars in Australia are being equipped with broadcast receivers and the sight and sound of an automobile providing music with transport is ceasing to be a novelty.

Communication system: A new intercommunication system, known as the "Handy-Phone", has been developed by the General Electric radio division in Bridgeport, Conn. Essentially a loudspeaker phone system, the new apparatus is designed for use in offices, hospitals, stores, homes or any similar place where speedy voice communication is desired.

Radiokes new factory: To cope with the present volume of business, and the general growth expected in suceeding years, Radiokes have just completed arrangements for the erection of a new factory in Vine Street, Redfern. It is expected the new building will be completed early in 1938.

RADIO, TELEVISION and HOBBIES

September 1962

Television transmitter: (caption) Designed to operate in Canberra on channel 3, this AWA television transmitter is the first Australian-made unit to be supplied to the Australian Broadcasting Commission. The equipment consists of two 10kW vision and associated sound transmitters, giving an effective radiated power of 100kW.

Sound into power: American scientists are now working on a device to make some use of the jet engine's noise.

A prototype set-up will soon test the feasibility of converting the jet's whine into electricity. The device will use the ability of some crystals to give off electricity when they are compressed. The sound waves of the jet vibrate the crystals and start the current flowing.

Electronic oven: (caption) In this British "Artic" 2kW electronic oven, frozen pre-cooked food becomes a piping hot meal in just 45 seconds. The oven cavity is of aluminium, with a stainless steel door, and measures 14in high, 17in wide and 15in deep. The manufacturer claims that there is no loss of moisture and no loss of flavour with electronic reheating.

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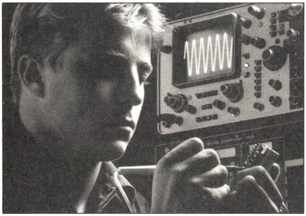

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The first multi-band transceiver that'll impress everyone except car thieves.

The new ICOM IC-900A is a totally new modular concept in multi-band amateur radio transceivers.

First, it's designed to fit into the stylish, compact instrument panels of modern cars rather than the glove box. Secondly the modular concept makes theft less attractive.

You see, what makes this concept so impressive is that the main and most expensive components of the radio can be secured and hidden away in the boot.

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The IC-900A is the first known to use optical fibre technology in an amateur transceiver. It uses optical fibre cable as a link from the two interface units. One for the remote controller and the other for the band units.

This provides an accurate display of frequency and memory data for any data for any two bands in use.

The IC-900A has a multi-band independent receive and transmit capability. So, it can monitor and use each installed band simultaneously, giving the effect of multiple transceivers.

The transceiver has 10 programmable memory channels in each band unit; up to 60 memories all together. Tuning can be selected in 5 KHz, 10 KHz, 15 KHz, 20 KHz and 25 KHz steps. Options include either the UT-28 Digital Code Squelch (DCS) unit or UT-29 Tone Squelch Unit.

The UX-19 band unit covers 28-30 MHz with 10/1 watt selectable output. The UX-59A covers 50-54 MHz at 10/1 watts. The UX-29A covers 144-148 MHz at 25/5 watts (a UX-29H version offers 45/5 watts). The UX-49A covers 430-440 MHz at 25/5 watts. And the UX-129A covers 1240- 1300 MHz.

If you find all this impressive, you'll be most pleased to read that the IC-900A handbook is excellent and simple to follow. Especially on installation procedure.

Perhaps the best thing to do is to visit your ICOM dealer and see how more impressive the IC-900A is in the flesh.

For details of your local dealer phone ICOM on Melbourne (03) 529 7582 or (008) 33 8915 from elsewhere in Australia.

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HENDERSON MERRICK DI STEFANO IC/456